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SEMANTICALLY-BASED THERAPEUTIC APPROACH THROUGH AIDED LANGUAGE
STIMULATION IN A CHILD WITH AUTISM SPECTRUM DISORDER

A Thesis

Submitted to the John G. Rangos Sr.

School of Health Sciences

Duquesne University

In partial fulfillment of the requirements for
the degree of Master of Science

By

Annemarie R. Hall

August 2014

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Annemarie R. Hall

2014

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STIMULATION IN A CHILD WITH AUTISM SPECTRUM DISORDER

By

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ABSTRACT

SEMANTICALLY-BASED THERAPEUTIC APPROACH THROUGH AIDED LANGUAGE STIMULATION IN A CHILD WITH AUTISM SPECTRUM DISORDER

By

Annemarie R. Hall

August 2014

Thesis supervised by Diane L. Williams, Ph.D.

The use of aided language stimulation in the context of a semantically-based therapeutic approach was studied using a single-subject design with a 7-year-old child with autism spectrum disorder who was minimally verbal. Techniques for increasing word retrieval (e.g., the repeated modeling of a small number of target words/symbols) were used in theme-based sessions in conjunction with modeling the use of picture symbols. Overall, the intervention had a small effect on the child's production of single spoken words, but had a large effect on her production of picture symbol combinations and spoken word + picture symbol combinations. No specific effect for word retrieval strategies occurred. The child produced the highest number of spoken words during a facilitated play condition. The structure of the sequenced procedure and book sharing conditions facilitated her production of semantic combinations. The participant

communicated more conceptual knowledge through spoken words + picture symbols than by words alone.

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CHAPTER I

Introduction

Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder strongly associated with deficits in language and communication that particularly affect social interaction (American Psychiatric Association, 1994). According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; APA, 2013) the standardized criteria for the diagnosis of ASD includes impairment in two main areas: social communication/interaction and restricted, repetitive behaviors. ASD is a spectrum disorder; meaning the nature and severity of symptoms are highly variable between individuals. Some individuals develop relatively high functional language skills, while approximately 60- 70% of children with ASD are low-verbal with substantial difficulty in the development of functional spoken language (Fombonne, 2005). At least one study has indicated that 15% of nine-year-olds with ASD spoke fewer than five words per day (Lord et al., 2006).

Language in ASD

Children with ASD who develop spoken language present with a wide range of language deficits particularly in the area of pragmatics but also in the areas of syntax and semantics (Walenski, Tager-Flusberg, & Ullman, 2006). Given that difficulty with social communication and interaction is one of the main criteria for ASD, problems with pragmatic language (or the functional use of language) are universal in this population. Pragmatic language incorporates social (knowledge of social rules that govern conversation) and real-world aspects (knowledge of how people and objects are likely to interact) of language. Speech acts, or utterances that serve a communicative function, are a specific area of pragmatic language that require knowledge of

how language is used within a culture (Grice, 1975). Children with ASD are reported to use speech acts to regulate the behavior of others but to have more difficulty using acts that promote social engagement (Wetherby, 1986). Wetherby and Prutting (1984) found children with ASD used gesture or spoken language to request objects or actions, to protest, and to self-regulate; however, they did not use speech acts with social functions, which included comments, showing off, acknowledging the listener, and requesting information. Additionally, initiation of social communication (i.e., joint attention, showing) is impaired relative to requesting (Landa, Holman, & Garrett-Mayer, 2007). Related to their pragmatic language problems, children with ASD also present with significant impairments in non-verbal communication, for example, reduced use of gestures to people or objects or to direct the attention of others (Mundy, Sigman, & Kasari, 1994).

In addition to problems with pragmatics, children with ASD have also been reported to have difficulty with syntax or the use of rule-governed combination of words into phrases and sentences (Walenski et al., 2006). Studies that compared children with ASD to children with Down syndrome or to children with developmental delays or typically development found that individuals with ASD present with reduced syntactic complexity in spontaneous speech (Eigsti, Bennetto, & Dadlani, 2007; Scarborough et al., 1991; Tager-Flusberg et al., 1990). Children with ASD also have reduced ability to produce novel, non-imitative utterances (Tager-Flusberg et al.) and increased production of non-meaningful utterances or jargon (Eigsti et al.).

While children with ASD have general difficulty with syntax, a number of studies have suggested that lexical knowledge remains largely unaffected in ASD or consistent with the individual's level of cognitive ability. Word-learning abilities appear to be relatively intact and performance on receptive lexical tasks as well as single-word production tasks is reported to be

relatively unimpaired as compared to cognitively-matched controls (Minshew, Goldstein, & Siegel, 1997; Norbury, Griffiths, & Nation, 2010). However, when individuals with ASD are asked to participate in rapid naming tasks or verbal fluency tasks, the reports are mixed with some individuals performing similarly to typically developing controls and others experiencing more difficulty (Minshew et al., 1995; 1997; Kjelgaard & Tager-Flusberg, 2001; Minshew, Goldstein, Muenz, & Payton, 1992; Rumsey, 1990; Tager-Flusberg, 2004). These findings suggest that, “although lexical knowledge itself may remain spared in ASD, there seem to be some deficits in retrieving or searching for this knowledge” (Walenski et al., 2006, p. 181). Therefore, children with ASD may acquire lexical items but may have difficulty in accessing and using these stored items for functional communication.

Summary. In summary, children with ASD have difficulty with acquiring spoken language, particularly the functional use of word combinations. Even though they may have relatively intact word-learning abilities, they may have difficulty with the productive use of the words that they know.

Augmentative and Alternative Communication

The use of augmentative and alternative communication (AAC) with children with ASD has been explored as a means of replacing or supplementing natural speech due to their substantial impairments in the acquisition of spoken language. The use of AAC with children with ASD has primarily been investigated with the respect to the effect it has on their use of spoken language or expressive communication.

Schlosser and Wendt (2008) conducted a systematic review examining the effects of AAC on speech production in individuals with ASD. After compiling and analyzing the results of nine single-subject experimental design studies and two group studies, the authors determined

that none of the studies reported a decline in speech production as a result of AAC intervention. Therefore, the data suggested that the use of AAC intervention would not impede the development of speech for communication. More positively, the data also suggested that AAC intervention resulted in gains in speech production for most participants (Schlosser & Wendt).

Picture exchange communication system. Specific types of AAC intervention have been investigated to examine the effects on increasing levels of speech production in children with ASD or children with developmental disabilities. One primary form that has been studied is the Picture Exchange Communication System or PECS (Frost & Bondy, 2002).

PECS is a picture-based AAC system that consists of three integrated components: 1) functional objectives, 2) situational reinforcement, and 3) development of communication and social skills with the overall focus on the use of pictures to interact with and request items from a communication partner (Frost & Bondy, 2002). Previous clinical studies have indicated that PECS is an effective intervention for teaching children to communicate and for developing spoken language in some children. For example, a review of communication intervention in ASD reported that 39 out of 66 children (59%) who used PECS for more than one year acquired speech as their sole means of communication (Brunner & Seung, 2009). Additionally, Ganz and Simpson (2004) evaluated the ability of PECS to increase the number of words spoken and complexity of word utterances in one child with ASD and in two children with developmental disabilities and characteristics of autism. Results indicated that all the participants made progress in mastery of the PECS system and had an increase in average intelligible words spoken per trial. Additionally, complexity of utterances increased from one-word utterances to three to four-word phrases (Ganz & Simpson).

Aided language stimulation. Another AAC intervention that utilizes a picture-based communication system is *aided language stimulation* (Goossens' and Elder, 1994; Goossens', 1989; Goossens', Crain, & Elder, 1992). In this interactive language intervention, the clinician highlights a symbol on the child's communication board while providing verbal input. The selection of the graphic symbol is always paired with a verbal model that shows the child that the symbols in front of him or her can be used individually or in combination to exchange information. The clinician's use of the graphic symbols also serves to provide augmented input to the child. This technique is thought to promote the development of both comprehension and production of communication with picture symbols (Goossens' et al., 1992). Aided language stimulation also allows the child to express a variety of communicative functions/semantic roles during interactions rather than focusing on the use of the picture-communication technique to request items.

The effectiveness of aided language stimulation was evaluated in a case study with a six-year-old girl with cerebral palsy who had no functional communication resulting from language impairments (Goossens', 1989). The participant underwent a 7-month augmentative communication intervention in which aided language stimulation techniques were utilized. After that time, the participant made significant gains in the use of picture-based communication as well as emerging verbal expression (Goossens', 1989). Therefore, this study supported the use of aided language stimulation techniques to increase both expressive and receptive language/communication.

Several additional studies have also evaluated the use of aided language stimulation in a number of children with developmental disabilities. Three of these are discussed in more detail below.

Bruno and Trembath (2006) conducted a study using a single-subject within subjects design to investigate the use of aided language stimulation as a means to improve syntactic performance by nine children with severe communication impairments who use AAC. The children's diagnoses included cerebral palsy, childhood apraxia of speech, schizencephaly, and Down syndrome. The intervention was conducted for two 45-minute therapy sessions per day for five consecutive days at a weeklong therapy camp for children with severe communication impairments who use AAC. Participants used either manual communication boards or dynamic display speech-generating devices (SGDs) as their AAC device and aided language stimulation was provided through these same devices. The results of the study suggested an increase of performance in regards to utterance length and complexity after use of aided language stimulation intervention providing further support that this technique can improve communication in children with severe communicative disabilities (Bruno & Tembath).

In another study examining the effects of aided language stimulation, Dada and Alant (2009) focused on vocabulary acquisition in children with little or no functional speech. This single-subject multi-probe study had four participants who ranged in age from 8 to 12 years and had fewer than 15 intelligible words. Each participant was diagnosed with either cerebral palsy or Down syndrome and had not received AAC intervention prior to the study. Aided language stimulation treatment was provided throughout five sessions targeting a total of 24 vocabulary words. The intervention was effective in promoting vocabulary acquisition in these children with minimal functional speech and their increased level of performance was maintained after treatment was removed (Dada & Alant).

Studies have also been conducted in which symbol comprehension was monitored simultaneously with verbal production during the implementation of aided language stimulation.

For example, Harris and Reichle (2004) completed a single-subject multi probe study (with baseline, intervention, and maintenance phases) with three preschool age children who had cognitive impairments and had little to no functional speech. The clinician used aided language stimulation during a scripted routine for a specific activity during the intervention phase. All of the participants made significant gains in comprehension and production during the intervention phase and maintained learned behaviors during the final phase of the study. The results suggested that aided language stimulation was an effective means to increase symbol comprehension as well as production in children with little to no functional speech (Harris & Reichle).

Use of aided language stimulation with ASD. The studies described above evaluated the use of aided language stimulation with children with various cognitive disabilities. There have also been investigations that specifically assessed the use of aided language stimulation with children diagnosed with ASD.

Cafiero (2001) conducted a single-subject design study with a 13-year-old with autism focusing on the effects of AAC intervention on the child's verbal output, behavior, and academic performance. The intervention consisted of a picture-based communication system with elements of aided language stimulation provided in a natural environment (i.e., the student's classroom) rather than a structured therapy session. After the intervention, the child's verbal communication had improved with increased length and complexity of utterances. Therefore, the study showed that picture-based communication with elements of aided language communication could improve communication functions in a child with ASD (Cafiero).

The effect of aided language stimulation on vocabulary comprehension and production by children with ASD has also been studied. Drager et al. (2006) conducted a single-subject

multiple probe design with two preschool-aged children diagnosed with autism who were identified as having severe communication impairments with fewer than 30 functional words. The investigation focused on the effectiveness of what was referred to as *aided language modeling* on increasing the comprehension and productive use of graphic symbols. Intervention took place at the daycare attended by both individuals with a total of 37 sessions conducted over 5 months. Each child made significant gains in symbol comprehension (i.e., identification of symbols) and production (i.e., use of symbols for object labeling) throughout the intervention phase. Performance was also maintained when measured after the intervention was withdrawn at the end of the school year. The results of the study demonstrated that clinician modeling can promote gains in both comprehension and production of graphic symbols for children with ASD (Drager et al.).

Summary. Picture communication systems, a form of AAC, have been used successfully to improve the expressive communication skills of children with ASD who have severe communication impairments. The instructional technique of aided language stimulation has been reported to be effective at increasing comprehension, the productive use of graphic symbols, and the production of spoken words in children with severe communication impairments with various developmental disabilities and in children with ASD with severe communication impairments. With respect to communicative functions, these studies have primarily emphasized the use of AAC for requesting of objects. As described above, aided language stimulation allows the child the possibility of expressing a variety of communicative functions/semantic roles; however, the effects of aided language stimulation on the development of the comprehension and use of other semantic roles has not been specifically investigated in children with ASD with severe communication impairments.

Use of Picture Support for Promotion of Word Retrieval

Besides serving as an alternative means of communication, picture support has been demonstrated to be effective in promoting increased utterance length in children with developmental disorders such as Down syndrome (Miles, Chapman, & Sindberg, 2006). Furthermore, this effect is thought to be related to the facilitation of word retrieval, a language processing skill reported to be affected in children with Down syndrome (Miles et al.). Although the method of facilitation has not been established, it is generally thought to function in one of two ways. First, the availability of pictures allow the child to express a thought even if they have difficulty encoding a concept into the form of a spoken word, therefore, reducing the demands on cognitive resources for formulation of the word (Miles et al.). Alternatively, because the pictures are static, they may help the child to hold the word in working memory allowing them to construct the needed model to say the word (Hughes, 2006).

As discussed earlier, like children with Down syndrome, some children with ASD also experience difficulty with word retrieval (Walenski et al., 2006). The use of picture support to promote word retrieval in children with ASD has not been studied. However, the evidence from the research with children with Down syndrome suggests the possibility of a facilitative effect for children with ASD. The use of picture support in the form of aided language stimulation may promote the use of spoken language in children with ASD by increasing the retrieval of spoken words. Such an effect would be consistent with the reports of strong word-learning but overall reduced use of spoken words in individuals with ASD.

Intervention Principles to Promote Word Retrieval

The provision of picture support alone does not fully address problems with word retrieval. Evidence-based practice for addressing word retrieval in children who have minimal

spoken language is lacking. However, several studies have reported successful intervention approaches for the promotion of word retrieval skills in children with developmental language disorders, specifically specific language impairment. For example, Ebbels et al. (2012) investigated the use of a semantic approach in the treatment of word-finding difficulties in children with receptive and expressive language impairments. This approach included sorting pictures by semantic categories and discussing semantic attributes of pictures. After receiving the semantically-based intervention, the 8 school-age children who participated in the intervention demonstrated significant improvement in word-finding abilities, suggesting that strengthening the semantic network of children with significant language impairments is beneficial (Ebbels et al.).

German (1992) has developed several intervention principles to target word finding based on her work with children and adolescents who use spoken language but who exhibit significant problems with word retrieval. One principle she defined for word-finding intervention was to “use relevant and thematic curriculum (German, p. 44).” German proposed that vocabulary should be drawn from the child’s curriculum, daily routines, recreational experiences, and home environment. For example, for students interested in sports, basketball or football could be used as the theme of word-retrieval lessons. A second principle German described was the importance of moving “from single word to discourse (p. 45).” According to this principle, vocabulary should initially be targeted in isolation and then within sentences and discourse. Another principle German espouses is the “ongoing rehearsal of vocabulary in isolation, sentences, and discourse (p. 45)” or the repetition of target vocabulary across linguistic contexts. The principles German outlined provide clinical guidelines for appropriate aspects of intervention for children with word-finding difficulties (German). Although, not previously studied, these intervention

principles for targeting word retrieval in children with specific language impairment could be potentially beneficial when targeting word retrieval difficulties in children with ASD.

Summary. The use of picture support has been explored as a means to promote word retrieval in individuals with developmental disabilities such as Down syndrome (Miles et al., 2006). Therefore, picture support may be beneficial for children with ASD, who have similar word-finding difficulties. In addition to picture support, semantically based word-finding interventions have been used to strengthen semantic networks and increase word-finding abilities in children with specific language impairment (Ebbels et al., 2012). German (1992) defined several clinical guidelines for word-finding intervention including using thematic vocabulary, expanding from single words to discourse, and repetition of target vocabulary. These clinical guidelines may also be applicable when addressing the word retrieval difficulties of children with ASD.

Purpose of the Study

Many children with ASD present with significant expressive language impairments characterized by minimal use of spoken words. Aided language stimulation has been effectively used to increase symbol comprehension and production in children with moderate to severe language impairments including those with ASD. Children with ASD have also been reported to have particular deficits in retrieving their lexical knowledge. Picture support has been shown to be effective in increasing the spoken language of children with Down syndrome who have problems with word retrieval. Although use of effective word retrieval strategies for children with ASD have not been studied, principles for effective intervention to promote word retrieval have been developed based on studies of therapeutic efficacy and expert clinical opinion for children with expressive language impairments. Therefore, picture support in the form of aided

language stimulation with the incorporation of the principles for the design of effective word retrieval intervention may be effective at increasing the productive use of spoken words representing single and combined semantic roles in minimally verbal children with ASD.

The current study examined the effect of aided language stimulation on increasing the use of spoken language with a low-verbal child diagnosed with ASD. Words representing different semantic roles were targeted to promote the production of single and two-word combinations to express functional communication beyond object labeling and requests for objects. Elements of effective therapeutic approaches for word retrieval problems, such as the use of semantically-related elements and elicitation of high levels of productive use, were also incorporated into the intervention.

Research Questions

The purpose of this single-subject design study was to evaluate the efficacy of an intervention using aided language stimulation within the context of a semantically-based therapeutic approach. The primary research questions were as follows:

1. Does the use of aided language stimulation in the context of a semantically-based therapeutic approach increase the number of single spoken words of target vocabulary produced by a child diagnosed with ASD who uses few spoken words functionally?
2. Does the use of aided language stimulation in the context of a semantically-based therapeutic approach increase the number of two-word spoken combinations with particular semantic relationships produced by a child diagnosed with ASD who use few spoken words functionally?

Independent Variables

One independent variable in this study was the use of aided language stimulation intervention in the form of six-symbol picture communication boards. The aided language stimulation intervention was implemented during three different conditions 1) facilitated play, 2) a sequenced procedure, and 3) book sharing. These conditions are described in detail in the Methods section below. A second independent variable was the controlled modeling of target vocabulary within intervention sessions and the controlled presence of word/symbols within conditions.

Dependent Variables

The dependent variables in this study consisted of measures of the child's spoken language, specifically, the number of single word utterances related to target vocabulary and the number of semantically-related two-word combinations the child produced. Additional dependent variables were measures of the child's expressive language including single picture symbol productions, picture symbol combinations, and word + picture symbol combinations.

CHAPTER II

Methods

This study was a single-subject experimental design with one participant with ASD with minimal spoken language. Three conditions were used consisting of facilitated play, book sharing, and a sequenced procedure. A six-symbol picture communication board containing text + picture support was used during the aided language stimulation intervention. Target vocabulary was selected so that aspects of a semantically-based therapeutic approach for word retrieval problems could be incorporated into the intervention.

Participant

The participant was a 7-year-old female with a diagnosis of receptive-expressive language delay secondary to her primary diagnosis of ASD. She was recruited from the Duquesne University Speech-Language-Hearing Clinic where she had received an initial evaluation at 6 years, 9 months of age. At that evaluation, the results of the *Peabody Picture Vocabulary Test, Fourth Edition* (PPVT-4; Dunn & Dunn, 2007), indicated that the child's receptive language skills were greater than 2 standard deviations below the mean placing her in the "extremely low" range. See results in Table 1.

Table 1

Results of the Peabody Picture Vocabulary Test-4

Raw Score	Standard Score	Percentile Rank	Interpretation
49	64	1	Extremely Low Score

Participant characterization measures. The *Autism Diagnostic Observation Schedule* (ADOS; Lord, Rutter, DiLavore, & Risi, 2002) was administered to verify that the participant exhibited behaviors consistent with the diagnosis of ASD. The ADOS, a semi-structured play assessment in which the child is presented with a number of situations, tasks, and demands, was

developed to establish the diagnosis of autism or ASD for research purposes (Lord et al., 1989).

The evaluator observes behaviors across (4) domains: communication, reciprocal social interaction, play, and stereotyped behaviors and restricted interests. See results of the ADOS in Table 2. The participant's algorithm scores exceeded the cut-offs for a diagnosis of autism.

Table 2

Results of the Autism Diagnostic Observation Schedule

Domain	Autism Spectrum*	Autism*	Participant's Scores
Communication	2	4	5
Reciprocal Social Interaction	4	7	11
Communication + Social	7	12	16
Imagination/Creativity	N/A	N/A	1
Stereotyped Behaviors and Restricted Interests	N/A	N/A	5

*Scores needed to meet diagnostic criteria

To meet the inclusion criteria for this study, the participant had to be in the *First Words* phase of expressive language acquisition as outlined by Tager-Flusberg et al. (1990). Children in this phase use non-imitated spontaneous single words to communicate about objects and events, including those outside of immediate context. At least some speech is intelligible and they use speech in a variety of contexts (e.g., labeling, requesting, commenting). The *MacArthur Communicative Development Inventory: Words and Gestures* (MCDI; Fenson et al., 1993) was completed by the child's mother to determine the child's level of understanding and use of words and word combinations. The first part of the form asks the parent to document the child's understanding of hundreds of early vocabulary items separated into semantic categories such as food and drink, animal names, and action words. The parent marks the words understood or used, and the measure yields separate indices of words understood and words produced. The second part of each form asks the parent to record the communicative and symbolic gestures the child has tried or completed. Results of the MCDI are provided in Table 3. The child's spoken

word performance as reported by her mother was consistent with the *First Words* stage of spoken word development.

Table 3

Results of the MacArthur Communicative Development Inventory: Words and Gestures

	Number	Percentile
Words Understood	247 (of 396)	35 th for 18 months old
Words Produced	36 (of 396)	10 th for 18 months old
Early Gestures	14 (of 18)	20 th for 18 months old
Later Gestures	37 (of 45)	55 th for 18 months old
Total Gestures	51 (of 63)	45 th for 18 months old

Prior to the first baseline session, the participant received a pure tone hearing screening, following standard clinical procedures. The child's hearing was found to be within normal limits at 25 dB for frequencies of 500 Hz, 1000 Hz, and 2000 Hz.

To determine whether or not the child could recognize items depicted as picture symbols, an identification assessment adapted from the one described in Harris and Reichle (2004) was used. Ten picture symbols enhanced with color (Mayer-Johnson, 2011) depicting common objects (e.g., book, ball, shoe) were presented in arrays of four symbol choices with one target item and three foils. The child was cued with "Find ____." The child responded with 100% accuracy by pointing to the pictured items when named by the examiner, during the identification assessment.

Setting

The study took place in a treatment room at the Duquesne University Speech-Language-Hearing Clinic. Each room allowed for video/audio recording through a wall-mounted video camera and wireless, integrated microphone system. Additionally, each room contained a

mirrored, one-way observation window through which the parents and clinical supervisor could observe. The child either sat on the floor or at a child-size table and chair as appropriate for the activity.

Materials

The primary materials used throughout the study were communication boards, props and adapted books. These are described in more detail below.

Communication boards. The intervention sessions were based on pre-selected themes, which were developed to include semantically-related vocabulary. These themes were selected in consultation with the participant's mother to determine what activities held a high level of interest for the child. Themes were also selected to include vocabulary that the child comprehended but did not use consistently in spoken words. The three themes were *baby*, *dog*, and *horse*. Six communication boards were developed for each theme, one for each of the three different activities within that theme: (a) facilitated play, (b) a sequenced procedure, and (c) book sharing. The picture + print communication boards for each activity were developed using *Mayer-Johnson Picture Communication Symbols* due to their high familiarity in the clinical setting (PCS; Mayer-Johnson, 2011). These picture symbols are simple colored line drawings of objects and actions with symbolic representations for other concepts. Each board contained six symbols 1.5 X 1.5 inches in size with corresponding print. The symbols were arranged in two rows, with three symbols across the top row and three symbols in the bottom row. The limited number of symbols per board allowed for an increased exposure to target vocabulary words but at the same time provided multiple opportunities for the development of two-word combinations. The number and arrangement of picture symbols was also consistent with the materials used in Harris and Reichle (2004). See examples in Appendices A, B, and C.

Props. Various props consisting of real objects were used during the conditions of facilitated play and sequenced procedural activities by the clinician and the participant. A majority of the props that were used had a corresponding picture symbol representation on the communication boards. For example, during the “dog themed” intervention sessions a stuffed dog, collar, leash, dog bowl, and bone were used to supplement activities. Additional props, which also corresponded to the theme, were introduced during the second treatment phase to maintain the participant’s interest in the activity. For example, in addition to the props described above, various play food such as cookies and french fries were used during the “dog themed” sessions of treatment phase 2.

Personalized books. Photographs of the participant and the props used within the facilitated play and sequenced activity conditions were taken by a research assistant using a Canon Powershot SX500 with a 30x Optical Zoom and 24 mm Wide-Angle Lens. The photographs were used to create customized four-page 8.5 x 11 books for the book sharing condition. Each page of the books also contained text corresponding with the photographic representations. The text consisted of two printed word combinations using vocabulary represented on a corresponding six-symbol communication board.

Procedures

Study design. This was a single-subject, treatment replication design with an initial baseline, then introduction, withdrawal, and re-introduction of the independent variable (i.e. ABAB, where A represents baseline sessions and B represents intervention). The first AB phase included the collection of baseline data followed by a period of intervention. This phase was replicated during the second AB phase. The second treatment phase was used to eliminate ethical

issues of ending treatment in a withdrawal phase and to provide further evidence of treatment efficacy.

During the baseline phases, the participant attended three sessions for a period of approximately 30 minutes each session (i.e., a total of 6 baseline sessions across the two phases). During the treatment phases, the participant attended 6 intervention sessions for a period of approximately 50 minutes each session (i.e., a total of 12 intervention sessions across the two phases). All baseline and intervention sessions were conducted by the graduate student investigator, hereafter referred to as the “clinician.”

Baseline sessions. According to Kratochwill et al. (2010), the purpose of baseline sessions is to “(a) document a pattern of behavior in need of change, and (b) document a pattern that has sufficiently consistent level and variability, with little or no trend, to allow comparison with a new pattern following intervention” (p. 19). Therefore, the participant attended three baseline sessions to allow the researcher to identify a consistent pattern of a behavior. Props associated with one of the three themes were used for one of the baseline sessions such that all three themes were introduced across the three sessions. A different order of presentation was used for the three themes during the second baseline period. Baseline sessions were limited to three, rather than the more desirable five, because the child’s off-task behaviors began to increase indicating a reduced tolerance for participation in sessions in which no adult-scaffolding was provided.

During the baseline sessions, the clinician engaged the participant in facilitated play during which one of the communication boards was available within the child’s reach, but it was not used by the clinician. A different theme was used for each of the three baseline sessions as

described above. The use of spoken words by the child was documented throughout all conditions for the baseline sessions.

The order of the facilitated play and sequenced procedure conditions was counter-balanced across the baseline phases. During the first baseline phase, the facilitated play condition was introduced first, followed by the sequenced procedure and book sharing activity. During the second baseline phase the sequenced procedure occurred first, followed by facilitated play and book sharing activity. The book sharing activity always occurred last because it was a re-telling of what occurred during the session and, therefore, was only pragmatically appropriate as the final activity.

Intervention sessions. The child participated in two treatment phases consisting of six intervention sessions each for a total of 12 sessions. During the intervention sessions, the clinician used aided language stimulation with picture communication boards as described in the Materials section, in the three conditions (facilitated play, sequenced procedure, and book sharing). Each activity occurred for approximately 15 minutes and after each activity the child was offered a “break” from intervention (i.e., bathroom, snack, preferred reinforcement activity of walking in the hallways). During the first treatment phase, the facilitated play activity was introduced first, followed by the sequenced procedure and the book sharing activity. During the second treatment phase, the sequenced procedure condition was introduced first, followed by the facilitated play and book sharing activity.

Aided language stimulation. In aided language stimulation, a facilitator “high-lights symbols on the user’s communication display as he or she interacts and communicates verbally with the user” by pointing to picture symbols that match the facilitator’s verbal models (Goossens’ et al., 1992, p. 101). A six-symbol communication board was developed using PCS

symbols enhanced with color for each of the activities. Each board included text and symbols representing the target words that are described in more detail below. The board was placed on the table or floor in front of the child during the related activity within easy physical reach.

Target vocabulary. During the aided language stimulation two *primary* target words/symbols were controlled across the three activities. For each theme, the target words controlled across the three activities were; Theme 1: Walk Dog, Theme 2: Wipe Baby, and Theme 3: Ride Horse. The clinician pointed to and verbalized each of these two target words a minimum of six times during each of the three activities within an intervention session as part of a two-word combination for a total of at least 18 models. The target words were chosen based on procedures established for treatment of word retrieval problems in children with spoken vocabulary. The target words were ones that the child was reported to comprehend but did not consistently use productively (German, 1992). The information provided by the parent on the *MacArthur Communicative Development Inventory: Words and Gestures* (Fenson et al., 1993) was used to create a list of words that the child was able to comprehend. Each intervention session was designed around two pre-selected target words from that list. For example, the parent reported that the child comprehended but did not functionally produce the words “dog” or “walk.” Therefore, each communication board created for the three conditions for the “dog” theme included the target words “dog” and “walk”. Clinician modeling of these target words was controlled across all three conditions.

Four additional words provided related vocabulary for the activities in the different conditions. These words were selected to create multiple opportunities for two-word combinations during the activities. In addition, two of these four additional vocabulary words remained consistent within each condition (i.e., facilitated play, a sequenced procedure, or book

sharing) across all the intervention sessions to allow for repeated presentation across contexts regardless of the theme. Each board created for facilitated play conditions contained the symbols for “big” and “little”. Each board for the sequenced procedures contained the picture symbols for “on” and “more”. Each board for the shared book activity contained the picture symbols for “big” and “on.” These consistent symbols were used throughout each instance of each condition across the 12 intervention sessions. However, the amount of clinician modeling of these was not controlled.

The final two words on the boards varied across the three conditions and across the three themes (i.e., dog, baby, horse) and were not specifically targeted with increased numbers of repetitions or opportunities for productive use. For example during the “dog theme” the two additional symbols on the communication board used during the facilitated play condition were “eat” and “food” and during the sequenced procedure condition were symbols “collar” and “leash.”

The position of the symbols displayed on each board was kept consistent across activities. Displaying the picture symbols in the same location was chosen to reduce the processing load for the participant, that is, to reduce the need for her to search for the picture symbols. Consistency of location was also thought to be consistent with the therapeutic approach of multiple repetitions and exposures of the target words. See Appendices A, B, and C for examples of communication boards.

Facilitated play. Facilitated play included the use of pre-selected toys chosen to be consistent with the theme for that session. The clinician engaged in play with the child and followed the child’s lead for activities, while modeling language and creating opportunities for the child to communicate with spoken language. For the facilitated play, preferred activities of

the child were selected based on information gathered in a parent interview. The facilitated play activity corresponded with the session theme (e.g., caring for a stuffed dog). The play was simple pretend play consistent with the child's cognitive level. For example, for the dog theme, play included making the dog walk and eat (and perform other actions as appropriate).

The clinician used aided language stimulation by modeling single words and two-word combinations (i.e., spoken words + points to the picture symbols) to label objects and actions, to make comments, and to answer questions during the play activity. In addition, the clinician used sabotage routines (i.e., playfully withholding items) as well as provided opportunities for choice-making to encourage the participant to spontaneously produce spoken words and point to picture symbols. Relevant props were used throughout play. Play continued until each of the two primary target vocabulary words were repeated for a minimum of six times each.

Sequenced procedures. A sequenced procedural task is carrying out an activity that has steps using associated materials; the steps of the activity are modeled by the clinician and then the child is encouraged to retell the steps while performing the activity. The clinician facilitated a three-step procedural activity with the child. Related props were used throughout the activity to supplement the procedural sequence. The first trial of the activity began with the prompt "First watch," and the clinician completed each step of the sequenced procedure while utilizing aided language stimulation. The second trial of the activity began with the prompt "Now help me," and the clinician encouraged the child to complete the sequenced procedure while using the communication board to tell each step. Cues were provided as needed throughout the activity such as "What now?" to encourage the child to tell the steps of the procedure. The third trial began with the prompt "Now tell me what we did," and was intended to be a retell of the activity using verbal language and points to picture symbols on the communication board. However, if

the child began to have difficulty with the retell of the steps, props were used to facilitate the final trial of the activity. Clinician models of two-word combinations using aided language stimulation were provided throughout all trials of the activity. An example of a sequenced procedure used during intervention was “walking a dog.” The steps for this sequenced procedure were: 1. collar on 2. leash on and 3. walk dog.

Book sharing. The book-sharing condition always occurred as the final condition in a baseline or intervention session. The communication board was held directly under the photograph on each page of the book to increase exposure and promote productive use of the picture symbols.

The first trial of the book-sharing condition began with the prompt “Listen,” and the clinician provided aided language stimulation while “reading” each page of the book. The clinician began the second trial of the condition with the prompt “(Participant’s name)’s turn to read!” Throughout the second trial the clinician used verbal prompts (i.e., “What happened?” “Tell me!”) to elicit story retell and verbal productions from the participant. The child and the clinician then engaged in a third trial of the book sharing activity, during which fewer verbal cues and increased amounts of expectant pausing were provided upon presentation of a new page. Aided language stimulation was used to reinforce target productions throughout all trials.

Data Collection

Data was collected during a 3-session no-intervention baseline period, a 6-session intervention period, a second 3-session no-intervention baseline period, and a final 6-session intervention period for a total of 18 sessions. Data collection consisted of transcripts of the video recorded sessions as described below.

Video recordings. Each session was video-recorded using the Intelligent Stream Recorder by Paragon Development Systems in the Duquesne University Speech-Language-Hearing Clinic. The speech of the clinician and the child was recorded verbatim using a Sennheiser body pack transmitter microphone, which has a frequency range of 740-776 MHz (Identification Number: 91013; Serial Number: 130373). A second video recording was collected during each session using a separate video camcorder mounted on a tripod in the room. This second recording was used as backup in case of equipment failure and if the speech sample taken from the ISR recording was unclear.

Language transcripts. Following the rules for transcription as indicated in the Systematic Analysis of Language Transcripts-English version software program (SALT; Miller & Chapman, 2010), the researcher created a language transcript for each session. The transcription was completed on a Dell OptiPlex 960 desktop as the researcher reviewed the video on a playback system. The SALT program was used to analyze and generate measurements of the transcribed language. Each transcript began and ended with the participant or clinician's first utterance that was relevant to the task. Unintelligible words were coded as "X" which is consistent with the SALT transcript protocol. The language transcript was inputted into the SALT software for automatic analysis of the child and clinician's total number of utterances, mean length of utterance, number of different words, number of total words, and mean turn length. Additional analysis was completed based on the SALT transcript as described in the sections below.

Reliability

To measure reliability of transcription of the language samples, a research assistant (i.e., a graduate student in speech-language pathology) viewed 10% of the language samples from

each of the four phases for a total of four samples. The research assistant independently created a second transcript from the video recordings. The independently created transcripts were compared to the transcript created by the researcher. The original transcript was marked to indicate the number of words for which there are disagreements (i.e., omissions, additions, or different words). Interrater reliability was measured through a unit-by-unit agreement ratio, which is a strict method of scoring agreement that requires that “two observers agree on the individual instances of the response being measured,” (Hedge, 1994, p. 130). Hedge (1994) explained that the unit-by-unit agreement ratio is calculated by first identifying the number of units (words in the language sample that are measured); then, the total number of units of disagreement is determined. The following formula was used to calculate the level of agreement: $(A / A + D) \times 100$ (where A = agree and D = disagree). There were no instances of disagreement between the two transcripts indicating that the transcripts were reliable representations of the information contained on the videos of the sessions.

Coding System

A coding scheme was used to apply a code each communicative event within the spoken language transcripts. A research assistant (i.e., a graduate student in speech language pathology program) coded the clinician’s utterances to eliminate researcher bias. The graduate student investigator (who had been the clinician) coded the child’s communicative behaviors/utterances. In addition, the research assistant coded the clinician’s model of the picture communication symbols/utterances. The researcher used the following coding scheme, modeled after the Communication Coding Scheme developed by Ronski and Sevcik (1996).

Table 4

Coding Scheme

Code	Mode
1.	Symbol production, clinician
2.	Symbol production, participant
3.	Single word production, clinician
4.	Single word production, participant
5.	Two symbol combination, clinician
6.	Two symbol combination, participant
7.	Two-word combination, clinician
8.	Two-word combination, participant
9.	Spoken word + picture symbol combination, clinician
10.	Spoken word + picture symbol combination, participant
11.	Unrelated Utterance, clinician
12.	Unrelated Utterance, participant

Symbol production. Use of the picture symbols on the communication board to point to a single referent within the context of conversation was coded as a symbol production. For example, if the client responded to the question “Big ball or little ball?” by pointing to the symbol for “little” on the communication board it was coded as a symbol production.

Single word production. A single word utterance was coded as single word production when the spoken word directly corresponded to a symbol/word represented on the communication board that was being used within an activity or within a previous activity.

Two-symbol combination. Use of the picture symbols on the communication board to point to a combination of referents as one communicative act was coded as two-symbol combination. For example, if the child responded to the question “Big ball or little ball?” by pointing to the symbols for “little” and “ball” on the communication board it was coded as a two symbol combination.

Two-word combinations. An utterance was coded as a two-word combination if it was directly related to the activity (contains symbols represented on current or previous communication board) and could be classified using a semantic role coding sheet (Retherford, 2000). A complete list of the semantic roles on the coding sheet can be found in Appendix D.

Word + picture symbol combination. An utterance was coded as a word + picture symbol combination if a combination of a spoken word and a point to a different picture symbol was used as one communicative act. For example, if the child verbally said the word “big” and then pointed to the picture symbol for “dog” on the communication board, it was coded as a word + picture symbol combination.

Unrelated utterance. Spoken language was coded as an unrelated utterance if it did not directly correspond to the activity occurring within the intervention session.

Coding Reliability

A research assistant (i.e., a graduate student in speech-language pathology) independently reviewed 10% of the transcripts from the facilitated play, sequenced procedural activity, and book sharing conditions for each of the four treatment phases (A1, A2, B1, and B2) for a total of four transcripts. During this viewing, the research assistant assigned codes to the individual transcripts using the coding schema described in the previous section. After the codes were assigned, they were compared to the ones assigned by the graduate student investigator to determine interrater reliability using the unit-by-unit agreement method described earlier. During the baseline phases, there were no instances in which the research assistant’s codes differed from the codes assigned by the investigator for 100% interrater reliability. During the initial treatment phase, the interrater reliability was determined to be 95%; during the second treatment phase, the interrater reliability was established to be 92%.

Data Analyses

The dependent variables that were included in further analyses were as follows: number of single spoken words related to target vocabulary, the number of semantically-related spoken two-word combinations, and the number of spoken word + picture symbol combinations.

Additional dependent variables also included in the analyses were the number of points to picture symbols and the number of picture symbol combinations produced by the child.

The data was then graphed with the session number on the x-axis and the relevant measure or outcome variable on the y-axis. A visual analysis of the data collected was used to determine whether there was a relationship between the independent variable and the outcome variable as well as the strength of that relationship as described in Kratochwill et al. (2010). Six features were examined: 1) level, 2) trend, 3) variability, 4) immediacy of the effect, 5) overlap, and 6) consistency of data patterns across similar phases. These features were assessed individually and collectively to determine if there was a causal relationship between the independent variable of aided language stimulation intervention and the outcome variables.

Level is defined as the mean measure for each of the dependent variables in a phase. Trend is the “slope of the best-fitting straight line for the data within a phase” (Kratochwill et al., 2010, p. 78). Variability is the standard deviation of each measure around the trend line. Immediacy of the effect is “the change in level between the last three data points in one phase and the first three data points of the next” phase (Kratochwill et al., 2010, p. 78). Overlap is the proportion or percentage of data points from one phase that overlaps with the data points from the comparison phase [with the desired outcome being a small percentage of overlap or conversely a large percentage of non-overlapping data (PND)]. Consistency is a comparison of the data from similar phases (baseline to baseline; treatment to treatment) to determine the extent to which these phases resemble each other.

Additionally, consistent with a recent meta-analysis of single participant research studies using AAC with individuals with ASD (Ganz et al., 2012), the Improvement Rate Difference (IRD; Parker et al., 2009) was calculated to determine the magnitude of change between baseline

and treatment sessions. IRD is recommended versus the more conventional Percentage of Non-overlapping Data (PND) because the results of a sample of 364 published data series (Parker et al., 2009) demonstrated that whereas neither PND nor IRD could discriminate among the most successful interventions, IRD was more useful for discriminating among interventions that were less successful (Ganz et al.).

IRD is a measure of the change in percent of high scores from a baseline (A) to an intervention phase (B) (Buckley and Newchuck, 2005; Thompson et al., 1998). In other words, “the improvement rate (IR) of the treatment phase minus the improvement rate of the baseline phase [$IR(t) - IR(b) = IRD$]” (Ganz et al., p. 62). A high score in the baseline is one which is above any of the scores from the comparison treatment session. If all the treatment phase scores (t) are above all the baseline phase scores (b), then the IRD would equal 1.00. If all the scores in the baseline and treatment phases are at the same level, then the IRD would be equal to 0.00 (Ganz et al.). Therefore, IRD has a maximum value of 1.00, indicating the most significant effect. Following the guidelines suggested by Parker et al. (2009), a small effect is indicated by an $IRD < .50$; a moderate effect by an IRD between .50 and .70; and, a large effect by an IRD of .70 or higher.

Measure of Fidelity

Two videotapes from each of the treatment phases were randomly selected for review by the research assistant. She coded clinician behaviors during delivery of the intervention. Each intervention procedure was rated as follows: 1– did not implement, 2 – implemented variably, or 3 – consistently and appropriately implemented. The research assistant specifically focused on the number of clinician models occurring throughout the intervention. If the clinician modeled the assigned two-word combinations using aided language stimulation at least six times within

each condition, the research assistant assigned a rating of 3. A rating of 2 was assigned if the clinician provided at least 6 appropriate models within at least one of the conditions. A rating of 1 was assigned if the clinician did not provide the appropriate models during all three conditions. The purpose of this rating system was to provide a measure of the fidelity with which the intervention was delivered. Within each intervention procedure the research assistant assigned a rating of 3, signifying a high measure of fidelity. The clinician delivered the intervention as planned in the study protocol.

CHAPTER III

Results

Single Spoken Words of Target Vocabulary

The first research question to be investigated in this study was “Does the use of aided language stimulation in the context of a semantically-based therapeutic approach increase the number of single spoken words of target vocabulary produced by a child diagnosed with ASD who uses few spoken words functionally?” Therefore, a primary measure of interest was the number of single words of target vocabulary spoken by the participant. Target vocabulary words were those that directly corresponded to a symbol/word represented on the communication boards used within the activity. The number of single spoken words produced across all conditions in each baseline and treatment session was recorded.

The means, standard deviations and ranges of the number of spoken target vocabulary words produced by the child in each phase of the intervention are presented in Table 5. Figure 1 represents the mean number of single spoken words produced by the child throughout all four phases of the intervention study. During treatment sessions, the participant made gains in the number of single spoken words produced.

Table 5

Means, standard deviations (SD), and ranges of numbers of single spoken words produced by the child for the four phases of the intervention study

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Mean (SD)	7.3 (8.08)	35.5 (15.5)	20.6 (15.01)	44.3 (23.2)
Range	0-16	9 - 52	6 – 36	15 - 68

Figure 1. Number of Single Spoken Words

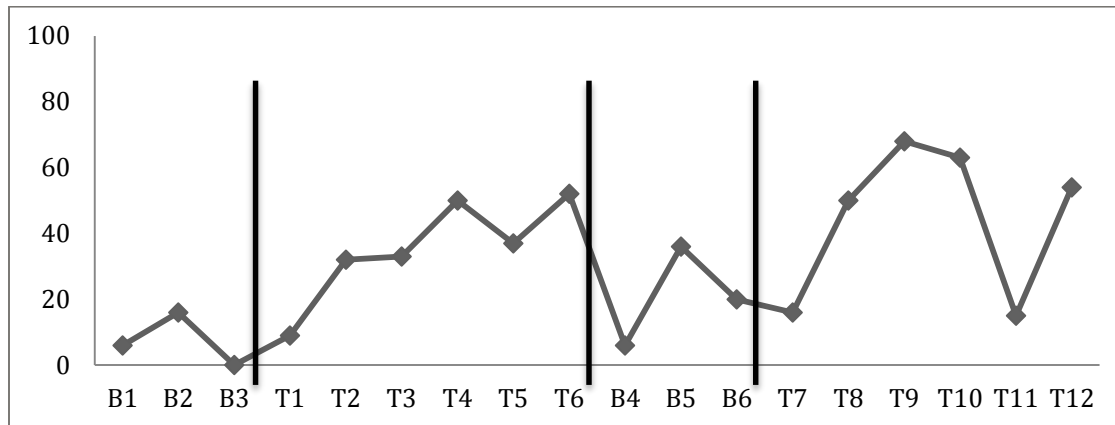


Figure 1. Number of single spoken words produced by the participant directly corresponding to target vocabulary. B = Baseline sessions. T = Treatment sessions.

Visual analysis of single spoken words. A visual analysis of the data was conducted to determine whether there was a relationship between the independent variable and the outcome variable and the strength of that relationship (as described in Kratochwill et al., 2010). The interpretation of the results of the visual analysis, including the predictable baseline pattern, level, variability, trend, immediacy of the effect, degree of overlap, and consistency of data patterns across similar phases is described in the following section.

Predictable baseline pattern. In determining the predictability of the baseline pattern, the measurement of interest was the number of single spoken words corresponding to target vocabulary. In the three initial baseline sessions, the participant used a range of 0 to 16 spoken word productions of the target vocabulary words. The high number in baseline session #2 was primarily due to the production of a specific vocabulary word (i.e., *baby*) that the mother reported was highly familiar to the child and had been used frequently by her in the past. Therefore, the child's use of spoken words was relatively consistent at a very low level across the three baseline sessions prior to the initiation of the treatment sessions.

Level. The level is the mean of all data points within a phase and is indicated by a solid horizontal line for each phase in Figure 2. The mean of single words produced was 7.3 at Baseline Phase 1, 35.5 within Treatment Phase 1, 20.6 during Baseline Phase 2, and 44.3 during Treatment Phase 2.

Figure 2. Level Analysis for the Number of Single Spoken Words

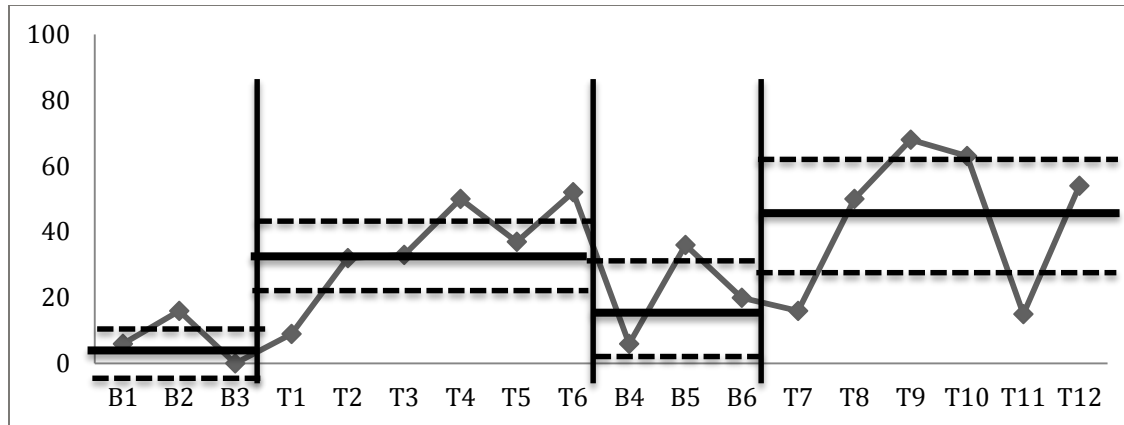


Figure 2. Level or mean of all data points within a phase for number of single spoken words. B = Baseline. T = Treatment sessions. Solid lines = mean. Dotted lines = ± 1 standard deviation.

Variability. The variability refers to “the fluctuation of the data (as reflected by the data’s range or standard deviation) around the mean” (Kratochwill et al., 2010, p. 5). The dotted lines in Figure 2 represent plus and minus one standard deviation from the mean. The most variability in performance occurred during the final treatment phase. As shown in Figure 2, the mean and standard deviation of treatment phases 1 and 2 are higher and do not overlap with those measures in the initial baseline.

Trend. The trend is the “slope of the best-fitting straight line for the data within a phase” (Kratochwill, et al., 2010, p. 78) and is shown in Figure 3 below as a solid line within each phase. For the purpose of this visual analysis, the data point T11 was removed from the trend line calculation. This marked a transition period for the participant and was acting as an outlier, causing a negative trend line which was not representative of the trend for the remaining five

data points. For the initial baseline, the data shows a slight decreasing trend line. Once the intervention was introduced during the treatment phase, the participant's productions increased and continued at a slightly increased level of performance until the treatment was withdrawn in the second baseline phase. In the second baseline phase, the participant's performance was much more variable with an immediate decrease in performance but then an increase resulting in an increasing trend line. When the treatment was re-introduced, the participant's productions immediately continued at a high level, though, in session T11, the participant began to go through a transition phase where she was using less spoken words and more verbal and picture symbol combinations, resulting in a minimally increasing trend line.

Figure 3. Trend for Number of Single Spoken Words

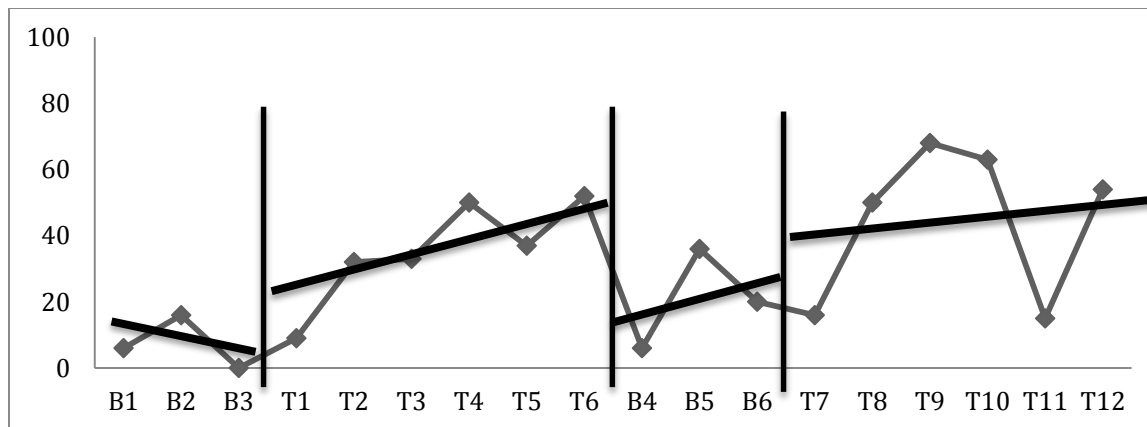


Figure 3. Trend or best fitting straight line and variability for number of single spoken words. B = Baseline. T = Treatment sessions.

Immediacy of Effect. Immediacy of the effect is “the change in level between the last three data points in one phase and the first three data points of the next phase” (Kratochwill et al., 2010, p. 78). As shown in Figure 4, the last three data points of one phase and the first three data points of the next phase were visually compared using shapes to indicate which data points are being compared (i.e., ovals, rectangles, and triangles). Comparisons revealed an immediate effect on the number of single spoken words produced between the first baseline and first

treatment phase, the first treatment phase and second baseline, and the second baseline and second treatment phase.

Figure 4. Immediacy of Effect for Number of Single Spoken Words

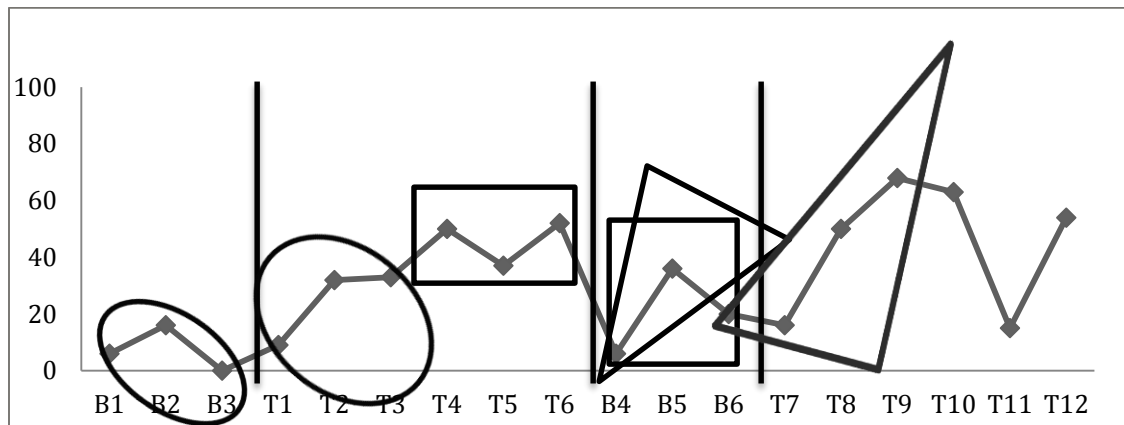


Figure 4. Visual analysis of immediacy of effect for number single spoken words. Similar shapes are used to indicate which data points should be compared to each other. B = Baseline. T = Treatment sessions.

Degree of overlap. The degree of overlap of data points between each adjacent phase was analyzed. Overlap is the proportion or percentage of data points from one phase that overlaps with the data points from the comparison phase [with the desired outcome being a small percentage of overlap]. As depicted in Figure 5, the number of single spoken words had one overlapping data point (17%) between the first baseline and the first treatment phase, 0% between the first treatment phase and the second baseline, and 33% between the second baseline and the second treatment phase, suggesting a strong effect each time the treatment was introduced and withdrawn.

Figure 5. Degree of Overlap for Number of Single Spoken Words

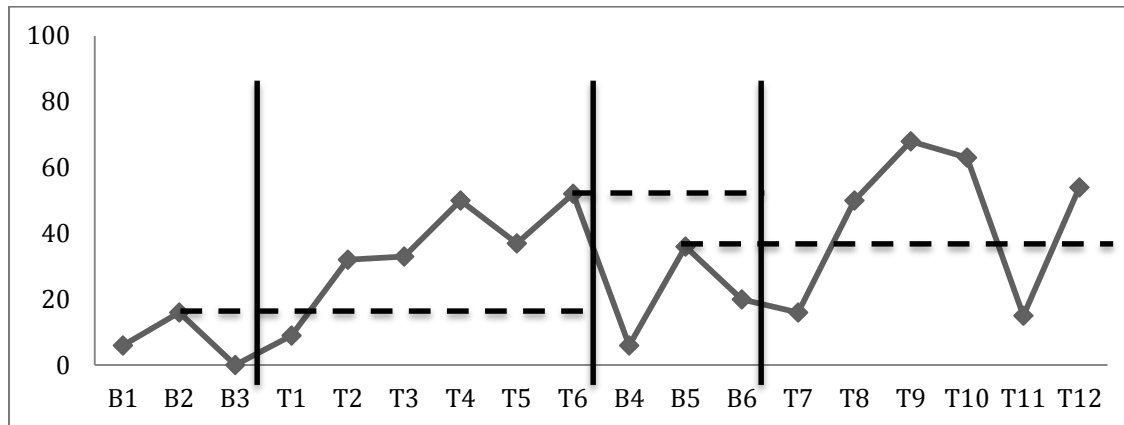


Figure 5. Visual analysis of degree of overlap for number of single spoken words when comparing adjacent phases. B = Baseline. T = Treatment sessions. Dotted lines indicate the highest data point for each of the four phases.

Consistency across phases. Consistency is a comparison of the data from similar phases (baseline to baseline; treatment to treatment) to determine the extent to which these phases resemble each other and is shown in Figure 6 by the linked ovals. The data patterns of similar phases indicated a consistent pattern between the two treatment phases and the two baseline phases.

Figure 6. Consistency across Phases for the Number of Single Spoken Words

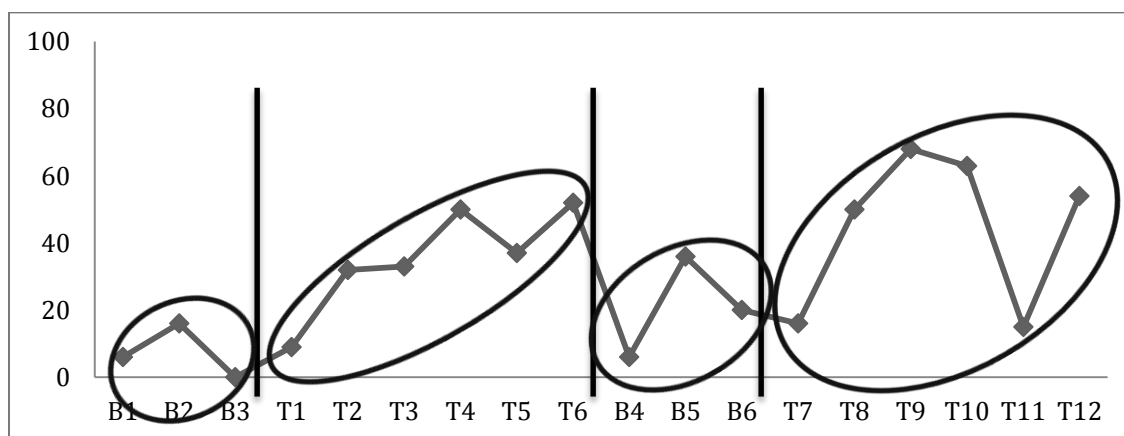


Figure 6. Visual analysis of the comparison of the consistency for number of coherent multiword utterances produced by the child without support across similar phases.

Improvement rate difference. For the current study, the IRD between the initial baseline and first treatment phase was calculated by subtracting the percent of high scores (those above any of the initial treatment phase scores) in the initial baseline phase (.33) from the percent of high scores in the initial treatment phase (.83) (those above any of the initial baseline scores), which yielded an IRD of .50. Therefore, there was a small to moderate effect size from the initial baseline to initial treatment phase. Similarly, effect size was calculated for the second phase of intervention by subtracting the percent of high score in the initial baseline phase (.33) from the percent of high scores in the second treatment phase (.67), which yielded an IRD of .33. Therefore, there was a small effect size in the overall pattern of increase in the child's production of single spoken words from the initial baseline phase to the second treatment phase. This latter result was related to the low number of single spoken words produced by the child in the initial and fifth sessions of the second treatment phase.

In summary, results indicated a small to moderate effect size from the initial baseline to initial treatment phase and a small effect size from the initial baseline phase to the second treatment phase. Therefore, the aided language stimulation had an overall small effect on the participant's production of single spoken words.

Single picture symbol productions. In addition to the child's production of single words, a secondary measure of interest was the number of single picture symbol productions across each baseline and treatment session. A communication turn was recorded as a *single picture symbol production* when the child pointed to a single symbol on her communication board during any of the three conditions. Table 6 contains the mean, standard deviation, and range of all single picture symbol productions across each phase. The child did not point to any picture symbols across the first baseline session even though the picture symbols were available

during all three conditions. However, the child steadily increased in picture symbol production during the treatment sessions which incorporated the use of aided language stimulation. An immediate decline in performance was noted when treatment was withdrawn during the second baseline phase; however, the child increased the number of picture symbol productions when intervention was reintroduced in the second treatment phase. The participant's productions were highly variable between treatment sessions, possibly due to a preference or high familiarity with a certain vocabulary item (i.e., *baby*).

Table 6

Means, standard deviations (SD), and ranges of numbers of single picture symbols produced by the child for the four phases of the intervention study

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Mean (SD)	0 (0)	77.3 (22.1)	31.6 (14.5)	133.8 (36.8)
Range	0	43 - 102	15 - 41	84 - 180

Two-Word Combinations

The second research question addressed in this study was “Does the use of aided language stimulation in the context of a semantically-based therapeutic approach increase the number of two-word spoken combinations with particular semantic relations produced by a child diagnosed with ASD who uses few functional spoken words?” The participant did not produce any two-word spoken utterance in any of the four phases of the intervention study. However, the child did produce a number of picture symbol combinations and spoken word + picture symbol combinations during the two treatment phases and the second baseline phase. Her performance on these measures is described below.

Picture symbol combinations. A picture symbol combination was defined as pointing to two or more picture symbols as a single communicative act. Figure 7 represents the number of

picture symbol combinations produced by the child throughout all intervention phases. No picture symbol combinations occurred during the initial baseline. During the first treatment phase the child steadily increased in production of picture symbol combinations. During the second baseline phase there was an immediate decline in production of picture symbol combinations when the aided language stimulation technique was withdrawn. When treatment was reintroduced during the second treatment phase, the number of picture symbol combinations continued to be produced at levels commensurate with or greater than in the first treatment phase. It was also observed that the leveling off of the increase in picture symbol combinations coincided with an increase in the child's production of spoken word + picture symbol combinations. The child's performance on that form of communication will be described below.

Figure 7. Number of Picture Symbol Combinations

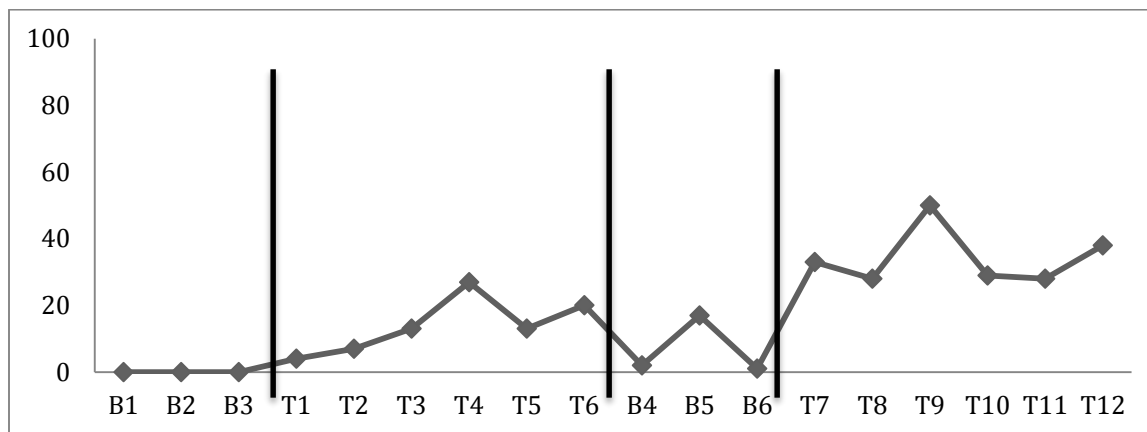


Figure 7. Number of picture symbol combinations produced by the participant for the four phases of the intervention study. B = Baseline. T = Treatment sessions.

Throughout treatment phases, the participant produced a large number of 2- symbol picture combinations as well as some 3-symbol picture combinations. Table 6 contains the mean, standard deviation, and range of all 2-symbol and 3-symbol picture combinations across each phase.

Table 7

Means, standard deviations (SD), and ranges of 2- and 3-picture symbol combinations produced by the child for the four phases of the intervention study

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Mean (SD)	0 (0)	14.0 (8.4)	6.7 (8.96)	34.3 (8.6)
Range	0-0	4 - 27	1 - 17	28 - 50

Improvement rate difference. The IRD for production of picture symbol combinations between the initial baseline and first treatment phase was calculated by subtracting the percent of high scores in the initial baseline phase (0%) from the percent of high scores in the initial treatment phase (100%), which yielded an IRD of 1.0. Therefore, there was a large effect size from the initial baseline to initial treatment phase for the child's production of picture symbol combinations during communication interactions. Similarly, an effect size was calculated for the second phase of intervention by subtracting the percent of high score in the initial baseline phase (0%) from the percent of high scores in the second treatment phase (100%), which also yielded an IRD of 1.0. Therefore, there was a large effect size from the initial baseline phase to the second treatment phase for the child's production of picture symbol combinations during communication interactions.

In summary, results indicated a large effect size from the initial baseline to initial treatment phase and a large effect size from the initial baseline phase to the second treatment phase. Therefore, the aided language stimulation had an overall large effect on the participant's production of picture symbol combinations.

Spoken Word + Picture Symbol Combinations

As described above, throughout treatment phases, the child did not produce a significant number of two-word spoken combinations. However, she did produce a relatively large number of spoken word + picture symbol combinations. A communication was considered a spoken word + picture symbol combination when the child verbalized a target word and then pointed to a different picture symbol (than the one representing the spoken word) as a single communicative act. The child's productions of spoken words + picture symbol combinations for each of the four phases of the intervention study are shown Figure 8. Throughout the initial baseline, first treatment phase, and second baseline phase the child remained relatively consistent in the number of spoken word + picture combinations she produced. The final three sessions of the second treatment phase were marked by a significant increase in these combinations.

Figure 8. Number of Spoken Word + Picture Combinations

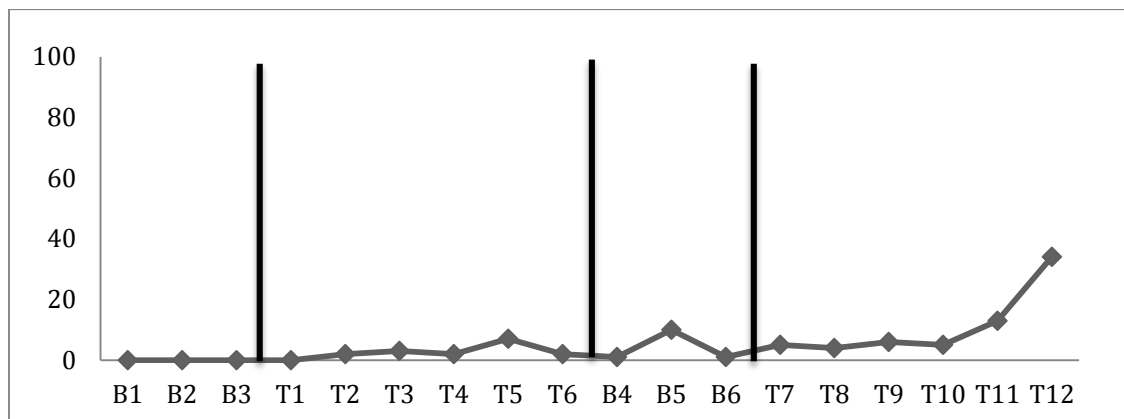


Figure 8. Number of spoken word + picture symbol combinations produced by the participant across the four phases of the intervention study. B = Baseline. T = Treatment sessions.

The means, standard deviations, and ranges for the child's production of spoken word + picture symbol combinations for each of the phases of the intervention study are displayed in Table 8.

Table 8

Means, standard deviations (SD), and ranges of spoken word + picture symbol combinations produced by the child for the four phases of the intervention study

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Mean (SD)	0 (0)	2.7 (2.3)	4.0 (5.2)	11.2 (11.7)
Range	0-0	0 – 7	1 - 10	26 - 46

Improvement rate difference. The IRD for production of spoken word + picture symbol combinations between the initial baseline and first treatment phase was calculated by subtracting the percent of high scores in the initial baseline phase (0%) from the percent of high scores in the initial treatment phase (100%), which yielded an IRD of 1.0. Therefore, there was a large effect size from the initial baseline to initial treatment phase indicating a reliable increase in the child's production of spoken words + picture symbol combinations. Similarly, an effect size was calculated for the second phase of intervention by subtracting the percent of high score in the initial baseline phase (0%) from the percent of high scores in the second treatment phase (100%), which yielded an IRD of 1.0. Therefore, there was also a large effect size from the initial baseline phase to the second treatment phase indicating that the reliable increase in the child's production of spoken words + picture symbol combinations persisted in the second treatment phase.

In summary, results indicated a large effect size from the initial baseline to initial treatment phase and a large effect size from the initial baseline phase to the second treatment phase. Therefore, the aided language stimulation had an overall large effect on the participant's production of spoken word + picture symbol combinations.

Effect of Conditions on Performance

In addition to examining the effects of the overall intervention on the child's expressive language skills, the potential effect of condition was analyzed. The child's performance (production of single spoken words, picture symbol combination, and spoken word + picture symbol combinations) within each of the three conditions: 1) facilitated play 2) sequenced procedure, and 3) book sharing was examined.

Single spoken words. Figure 9 shows the number of single spoken words produced by the child throughout all three conditions. Table 9 provides the mean number of single spoken words produced by the child across each phase and condition.

Figure 9. Number of Single Spoken Words by Condition

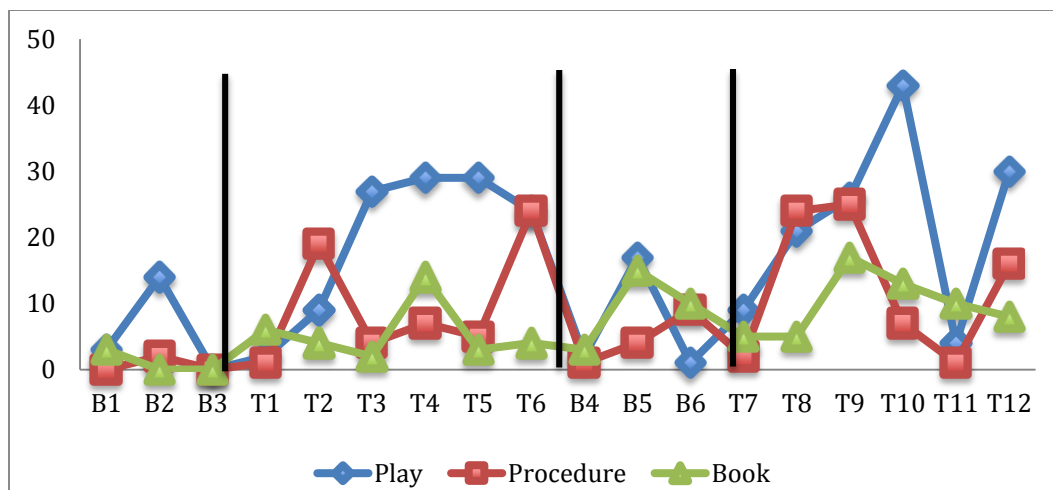


Figure 9. Number of single spoken words produced by the child per condition. B = Baseline. T = Treatment sessions.

Table 9

Mean number of single spoken words produced by the child per condition for each phase of the intervention study

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Play	3	20	6.6	22.2
Procedure	.6	10	4.6	12.5
Book	1	5.5	9.3	9.6

Across the initial baseline, first treatment phase, and second treatment phase, the largest number of single spoken words were produced during the facilitated play condition. This may be because the participant had an increased number of opportunities for response due to the lack of structure during the play condition. This suggests that the facilitated play condition was the one that was most effective for eliciting spoken words from the child.

Picture symbol combinations. Figure 10 displays the number of picture symbol combinations produced by the child in each phase of the intervention study. The mean number of picture symbol combinations by condition are presented in Table 10.

Figure 10. Number of Picture Symbol Combinations by Condition

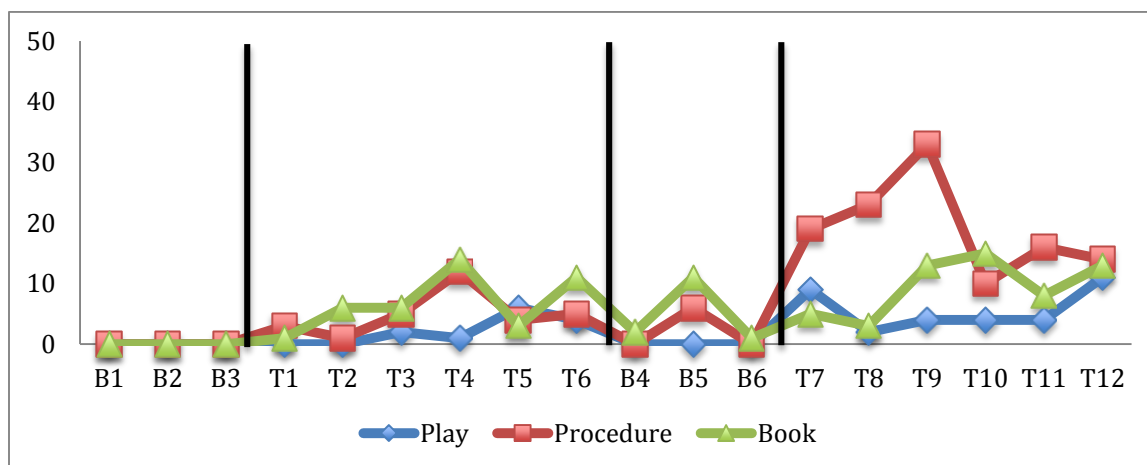


Figure 10. Number of picture symbol combinations produced by the child per condition. B = Baseline. T = Treatment session.

Table 10

Mean number of picture symbol combinations produced by the child per condition for each phase of the intervention study

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Play	0	2.2	0	5.6
Procedure	0	5	2	19.2
Book	0	6.8	4.6	9.5

Across the first treatment phase the child produced the greatest number of picture symbol combinations during the shared book reading condition. Across the second baseline phase, the child continued to produce the greatest number of picture symbol combinations during the shared book reading condition. However, during the second treatment phase, the number of picture symbol combinations produced during the sequenced procedure condition exceeded the number of combinations produced during the shared book reading condition. Across all phases, the smallest number of picture symbol productions occurred during the facilitated play condition. This suggests the added structure of the sequenced procedure and book sharing conditions facilitated an increased production of semantic combinations.

Spoken word + picture symbol combinations. Figure 11 represents the number of word + picture symbol combinations produced by the child throughout all conditions. Table 11 provides the mean number of word + picture symbol combinations produced by the child across each phase and condition. The number of spoken word + picture productions remained relatively consistent throughout each condition of intervention. Analysis shows little to no condition effect, in regards to spoken word + picture symbol productions. However during the last intervention session, an upward trend in the production of these combinations during the facilitated play and the sequenced procedural task was noted.

Figure 11. Spoken Word + Picture Symbol Combinations per Condition

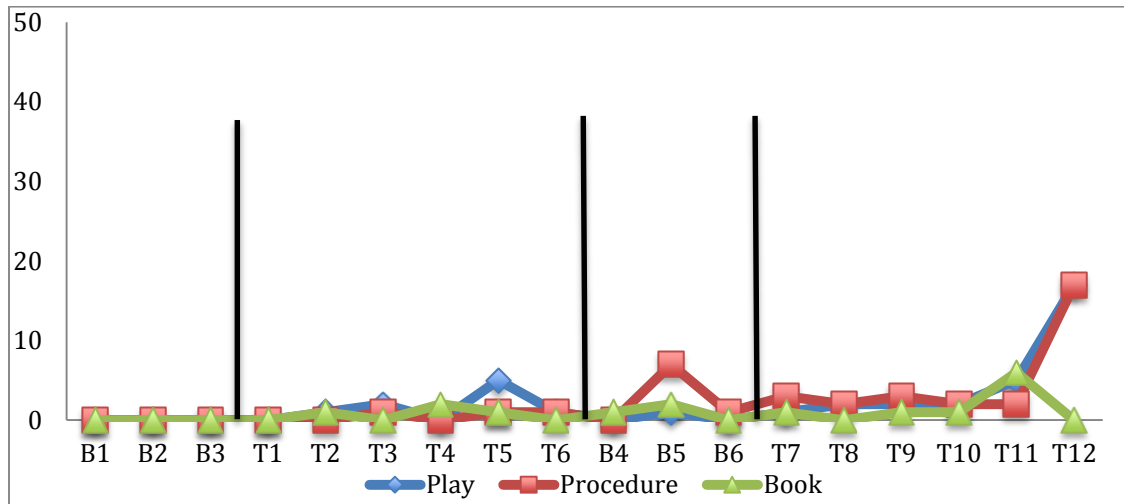


Figure 11. Number of spoken word + picture symbol combinations produced by the child per condition. B = Baseline. T = Treatment sessions.

Table 11

Mean number of spoken words + picture symbol combinations produced by the child per condition

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Play	0	1.5	.3	4.8
Procedure	0	.5	2.6	4.8
Book	0	.6	1	1.5

Trial Effect

An additional aspect of the intervention that was analyzed was the child's performance within each trial of a condition. During each session, the child participated in three trials of the sequenced procedures and book sharing activities. The child's productions of single spoken words and picture symbol combinations were analyzed to determine the effect, if any, of trial number on performance. This analysis provided information as to whether repetition of the activities had an effect on the child's productions.

Single spoken words. Throughout the shared book sharing and sequenced procedure conditions, the child's mean number of single spoken words increased with each trial, with a relatively larger increase from Trial 1 to Trial 2 and a smaller increase from Trial 2 to Trial 3. This suggests that multiple repetitions of an activity increased the number of single spoken words the child produced. See Table 12.

Table 12

Mean number of single spoken words produced by the child per trial for sequenced procedures and book sharing activities combined

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Trial 1	.2	1.9	1.3	2.3
Trial 2	.3	2.8	2.6	4.25
Trial 3	.3	3	3	4.5

Picture symbol combinations. On average, the number of picture symbol combinations produced by the child during the sequenced procedure and book sharing activities initially increased from Trial 1 to Trial 2, but then decreased from Trial 2 to Trial 3. Therefore, on average, the child produced the greatest number of picture symbol combinations during Trial 2 for these conditions. See Table 13. The data suggest that after successfully relating the steps of the sequenced procedure or the activities portrayed in the book by communicating with the picture symbols (Trial 2), the child did not necessarily repeat this performance for an additional trial (Trial 3).

Table 13

Mean number of picture symbol combinations per trial produced by the child for the sequenced procedure and book sharing activities

	Baseline 1	Treatment 1	Baseline 2	Treatment 2
Trial 1	0	1.2	1.2	5.4
Trial 2	0	2.6	1.5	5.3
Trial 3	0	2	1	3.5

Semantic Analysis

The child's expressive output in spoken words and picture symbols was analyzed using SALT which provided the traditional language measures of mean length of utterance (MLU), number of different words (NDW), and number of total words (NTW). Each measure of language was calculated using two variations of a transcript from each session. One transcript included only spoken language and the second transcript included spoken words and picture symbol use as measures of expressive language. These two measures were then analyzed to assess the child's ability to communicate conceptual knowledge through spoken words as compared to her ability to communicate that knowledge through spoken words augmented with the use of picture symbols.

Mean length of utterance (MLU). The MLU provided a measure of the child's ability to combine concepts either through spoken words or through the use of spoken words and picture symbols. See Table 14 for the MLU for both measures across all baseline and treatment phases. In general, the child's MLU was greater when her spoken language was combined with picture symbols than for spoken language productions alone. This suggests that the availability of the picture symbols made it possible for the child to combine concepts more easily than by the use of only spoken words. See Table 14 for MLU measurements for spoken words alone and a

combination of spoken words and picture symbols by session for all four phases of the intervention study.

Table 14

MLU measurements for the initial baseline and treatment phase comparing spoken words to spoken words combined with picture symbols

MLU Measures		
	Spoken Words	Spoken Words Combined with Picture Symbols
B1	1	1
B2	1.1	1.1
B3	1	1
T1	1.12	1.09
T2	1.03	1.09
T3	1.24	1.29
T4	1.09	1.28
T5	1.16	1.29
T6	1.09	1.24
B4	1.24	1.12
B5	1.09	1.43
B6	1.15	1.1
T7	1.27	1.37
T8	1.21	1.24
T9	1.11	1.33
T10	1.1	1.24
T11	1.19	1.34
T12	1.07	1.33

Number of different words (NDW) and number of total words (NTW). Measures were taken to analyze the NDW and NTW across all phases for spoken word productions and for spoken words combined with picture symbol productions. It should be noted that across all three conditions in a single session, the maximum number of different words the child could express by pointing to a picture symbol was constant at 10 symbols. Despite this limitation, the child's

NDW and NTW increased from the initial baseline phase to the final treatment phase for both types of productions. Furthermore, across all phases, the child produced a greater number of different words and a greater number of total words when measurements included picture symbol productions. This provides evidence that picture symbol support increased the child's overall expressive language abilities. See Table 15 for the NDW and NTW produced verbally and with picture symbol combinations within each baseline and treatment session.

Table 15

The Number of Different Words and the Number of Total Words produced by the child either through spoken words alone or through spoken words and picture symbols for each session of the intervention study

	NDW Spoken	NDW Spoken and Picture Symbols	NTW Spoken	NTW Spoken and Picture Symbols
B1	5	8	5	8
B2	7	11	7	11
B3	1	2	1	2
T1	11	15	19	62
T2	6	10	37	101
T3	12	13	51	121
T4	18	18	70	210
T5	11	12	58	108
T6	13	14	70	165
B4	14	17	21	64
B5	11	11	49	93
B6	9	12	31	56
T7	19	24	38	198
T8	25	27	82	273
T9	28	29	100	308
T10	14	20	88	245
T11	17	18	43	185
T12	22	23	124	326

*Note: Across all conditions in a single session, 10 different picture symbols were represented on communication boards

**NDW = Number of Different Words

***NTW = Number of Total Words

Follow Up

Parent interview. A qualitative parent interview was conducted with the child's mother post intervention to provide additional information pertaining to her viewpoint of the treatment

her child received. The mother had observed all treatment sessions and was aware of the purpose of the study. The child's mother indicated that she found the intervention beneficial and thought that her child "responded to the picture cards very well." The mother stated that she thought that her child enjoyed the intervention "as long as it was rotated around something she liked." In regards to changes in expressive language abilities, the mother stated that her child produced "more words" and "puts two words together." Additionally, she noted that others had noticed a change in the child's expressive language including extended family members. The mother also stated that, "Teachers at school say she's making a ton of progress." In regards to possible changes in the intervention protocol, the child's mother stated that less structure within intervention tasks may have benefited the child and reduced problem behaviors. See Appendix E for a complete transcription of the parent interview.

Clinical report of child's progress. Immediately following the study, the child was enrolled at the Duquesne University Speech-Language-Hearing Clinic to receive individual therapy, utilizing intervention protocols that were similar to the ones used for the study. Therapy sessions continued to focus on relevant thematic target vocabulary. Picture symbol communication boards and picture-symbol *strips* comprised of combinations of picture symbols to represent an action or event were used in conjunction with aided language stimulation to promote expressive language skills. Therapy was presented in the context of the same three conditions: (a) facilitated play, (b) a sequenced procedure, and (c) book sharing. The following information was obtained through clinical documentation, and inter-rater reliability was not completed. After five sessions of individual therapy, the child produced two- to three-word semantic relationships approximately 70% of the time when provided with the opportunity given aided language stimulation during facilitated play activities. The child produced spoken words to

relate two to four steps of a sequenced procedure with 75% accuracy when cued with picture symbol strips; her performance increased to 100% accuracy when she was given phonemic cues and cued with referential pointing. During a picture book sharing activity, the child produced two- to three-word spoken phrases with 65% accuracy with print + picture symbol support. The child's continued progress during individual therapy sessions suggested that print + picture support and aided language stimulation were appropriate methods for improving expressive language skills for this particular child with ASD.

Summary of Results

This single-subject study indicated that aided language stimulation intervention in the context of a semantically-based therapeutic approach was effective in eliciting the production of picture symbol combinations and word + picture symbol combinations in a child with ASD who had minimal spoken language skills. A smaller effect was obtained on the child's production of single spoken words. When examining the condition effects on performance, the facilitated play condition was determined to be the most effective for eliciting single spoken word productions whereas the sequenced procedure and book sharing conditions were most effective in eliciting picture symbol combinations. Throughout the study, the participant also demonstrated the ability to communicate more conceptual knowledge through words + picture symbols than by words alone. However, aspects derived from intervention for word retrieval with children with specific language impairment such as the repeated modeling of a small number of target words/symbols to promote rehearsal across the conditions did not appear to be effective in promoting use of these specific items for this minimally-verbal child with ASD.

CHAPTER IV

Discussion

The purpose of this single-subject experimental design study was to evaluate the efficacy of aided language stimulation within the context of a semantically-based approach with a 7-year-old girl with ASD who had minimal spoken language skills. The results indicated that aided language stimulation had a positive impact on the expressive language skills for this particular child. Her production of single spoken words as well as single picture symbol productions increased. Additionally, the child's production of picture symbol combinations as well as spoken word + picture symbol combinations increased.

One anomaly to the child's overall pattern of increased production of spoken words during the intervention sessions was noted. When treatment was reintroduced in the second treatment phase, the child continued to make gains in the number of single words produced until the fifth treatment session (i.e., 11th treatment session in the study). During that session, the participant dramatically decreased in the number of single spoken words she produced. The child's performance with picture symbol combinations followed a similar pattern to that of her single spoken words productions. The second half of the second treatment phase is marked by a decline in picture symbol production coinciding with her decrease in the production of single spoken words. These decreases in the child's production of spoken words and picture symbol combinations do not necessarily indicate a decline in her communicative performance. Rather, these declines coincide with an increase in the child's productions of spoken words + picture symbol combinations. Therefore, the decline in performance of some of her communicative behaviors appear to indicate a transition period from single spoken words to spoken word +

picture combinations as the number of those combinations began to increase during that same period of time.

Linguistic transition periods have been studied in typical language learners (Tamis-Lemonda, Bornstein, Kahana-Kalman, Baumwell, & Cyphers, 1998). For example, three key language milestones in toddlers: (a) 50 words in production, (b) combinatorial speech, and (c) language used to express memory were examined in a longitudinal investigation (Tamis-Lemonda et al.). These linguistic milestones are thought to reflect not only changes in the level of spoken language but also “underlying transitions in toddler’s cognitive representational abilities” (Tamis-Lemonda et al., pg. 696). For example, reaching the level of 50 words in production has been identified as the start of a new period in language growth or a ‘vocabulary spurt’ and has been associated with changes in conceptual development and the ability to categorize objects (Tamis-Lemonda et al.). Additionally, “the transition to combinatorial speech is thought to index global cognitive achievements that extend beyond the domain of language” (Tamis-Lemonda et al., pg. 696). Therefore, it is hypothesized that linguistic transition periods may signify a shift in cognitive development. The participant in the current study appeared to experience a linguistic transition period, moving from single words to spoken word + picture symbol combinations, an event which may represent a shift in her cognitive development, similar to that observed in typical language learners.

In addition to analyzing the overall effectiveness of the use of aided language stimulation during intervention, measurements were taken to analyze the participant’s productions within each condition of the intervention sessions. Although six-symbol picture communication boards were used for each of the three conditions or activities, the activities differed with respect to the type of engagement and the constraint on communication. That is, the facilitated play activity

was primarily child-directed and the child had opportunities to determine the comments or requests she would make. The sequenced procedural task had steps that needed to be expressed and completed in a specific order creating a situation in which some responses were acceptable and others were not. However, like the facilitated play, the communication referred to physical tasks that were immediately completed while using concrete, physical props. Like the sequenced procedural task, the book sharing activity had the expectation of specific information related to the action depicted in the photographs, again creating a situation with acceptable and unacceptable responses. However, unlike the play and sequenced tasks, the book sharing activity was more abstract, with the communication referring to already occurring events and no physical props.

The number of single words, picture symbol combinations, and spoken word + picture symbol combinations were measured within the facilitated play, sequenced procedure, and book sharing conditions. Across both treatment phases, the child produced the largest average number of single spoken-word productions during the facilitated play condition which was likely related to the increased number of communication opportunities during this condition. Because the facilitated play condition was not a structured activity, there were an unlimited number of communication interactions between the participant and clinician. The child was also able to direct the activity, using the familiar communicative functions of requesting and commenting.

While the facilitated play condition was determined to be the most effective in eliciting single spoken word productions, the child produced the least number of picture symbol combinations during this condition. Across the first treatment phase, the participant produced the largest number of picture symbol combinations during the book sharing condition. However, across the second treatment phase, the participant produced the largest number of picture symbol

combinations during the sequenced procedure. The greater number of picture symbol combination produced during the sequenced procedure and book sharing conditions suggests that the structured activities were more beneficial in eliciting the production of semantic combinations. The nature of the acceptable responses for these tasks was important in encouraging the use of the picture symbol combinations. That is, a minimum of two-symbol combinations was necessary for the child to accurately convey the step (i.e., in the sequenced procedure) or the pictured action (i.e., in the book sharing activity). Thus, it is not unexpected that these activities would elicit higher levels of picture symbol combinations than the facilitated play. However, the symbols were presented in a six-symbol board format and not explicit sequenced picture strips. Therefore, the child had to locate the appropriate symbols from the array of six and relate them to a specific step in the sequence or pictured action in the book, a task requiring a certain level of cognitive understanding and productive language use that was not evident in her performance before the initiation of the intervention.

The results of this study are consistent with a model of memory in ASD that maintains the declarative memory system is intact with relatively more impaired function in the procedural memory system (Walenski et al., 2006). Declarative memory includes long-term learning, representation, and use of knowledge about facts, what is sometimes referred to as *semantic memory*, combined with knowledge about personal experiences, what is sometimes referred to as *episodic memory* (Squire, Clark, & Bayley, 2004). The procedural memory system includes learning of new, and the control of already established motor and cognitive skills that involve sequences (Schacter & Tulving, 1994). The procedural memory system is also largely responsible for learning and use of linguistic rules such as syntax (or combinations of linguistic units), morphology, and phonology (Ullman, 2004). Researchers state that “declarative memory

is often largely spared in ASD, resulting in a relative sparing of lexical knowledge, though the retrieval or search of this knowledge may tend to be problematic” (Walenski et al., 2006, p. 188). The procedural memory system is relatively more impaired in ASD, resulting in a need for compensatory use of the declarative memory system to perform functions usually facilitate by the procedural memory (Walenski et al.).

In the current study, when the child participated in the facilitated play activity, she was not given any external support for procedural memory or the combination of conceptual or linguistic knowledge and she produced the fewest number of semantic combinations. However when the child participated in the structured tasks in which she was given external support for sequenced information (similar to what is thought to be provided cognitively by the procedural memory system), the child produced a greater number of semantic combinations.

Another important aspect of the intervention implemented in this study was the use of strategies to promote word retrieval. Based on principles outlined for word retrieval intervention (German 1992), two primary target words/symbols were presented consistently across the three activities in each intervention session. Modeling of these target words/symbols was controlled (at least six times within each activity) in order to facilitate ongoing rehearsal of target vocabulary across linguistic context. When analyzing the participant’s productions of picture symbol combinations, there was no significant difference between the number of picture symbol combinations which included the two primary target words/symbols and other picture symbol combinations produced throughout the study. Therefore, the controlled modeling of two target words/symbols across contexts did not appear to affect the participant’s production of picture symbol combinations. The overall act of using aided language stimulation to model two-word picture symbol combinations and the use of activities with an inherent structure appeared to have

a more significant impact on the child's productions, regardless of which target word/symbols were being modeled.

Multiple trials were provided during the sequenced procedure and book sharing activities to be consistent with models of intervention that hold that repeated retrieval of semantic information is important for increasing the individual's ability to produce lexical items (German, 1992). On average, the child produced the largest number of single spoken words during the third trial of each activity. This provided evidence that the participant produced more single spoken words with repetition of each activity as expected. However, contrasting results were found when analyzing trial effect for picture symbol combinations. On average, the child produced the largest number of picture symbol combinations during the second trial of the sequenced procedure and book sharing conditions. Therefore, in the current study, increased repetition of the structured activities did not necessarily improve the child's performance in terms of combining semantic concepts but did increase the child's use of single spoken words, suggesting some facilitatory effect for word retrieval.

Overall throughout each treatment session, the child expressed the most conceptual knowledge through the use of her spoken words when they were combined with the picture symbols. The picture symbols appeared to provide her support for her word retrieval difficulties. However, the presence of a picture symbols did not in itself alleviate the difficulty the child had with expressing herself through language. Whereas, the child's direction of the play activity combined with the clinician mapping her language onto the child's actions appeared to be an important facilitator in eliciting spoken words, the structured activities appeared to elicit more combinations of concepts.

Limitations

The study's single-subject design was a study limitation because the findings cannot be generalized to the larger population of all children with ASD. Given the positive effects evidenced in this initial study, further examination of this intervention with more children is warranted.

The limited number of target vocabulary used throughout the intervention was another limitation of this study. Each communication board only contained six picture symbols, which meant that there was a finite number of meaningful semantic combinations that could be expressed by the child. Additionally, so that effects of the target vocabulary could be examined across the three conditions, all picture symbols were presented in the same format (i.e., a 2 X 3 communication board); additional formats (i.e., sequenced picture communication strips mapped to each step of the procedural sequence or pictured action of the book) may have reduced the cognitive load during the early presentations of these activities. The picture strip format may have helped the participant more easily relate the steps or depicted pictured actions. The child could then have moved from this format to the six-symbol picture communication boards after establishing familiarity with the expected responses.

Follow-up measures for in this study had some limitations. Although an interview was conducted to gain an understanding of parent perspective and impressions, it was not clearly established that the intervention resulted in an increase of the child's use of picture symbols in the home or school environment as no actual observations or data collection were conducted in those settings. Additionally, the clinical report of the child's progress was written by an independent clinician who did not follow the strict coding scheme developed for this particular study meaning that these measures are not ones that met research standards of reliability.

Future Directions

Given the initial evidence for effectiveness provided by this study, it should be replicated with additional participants to provide evidence of whether not these results can be generalized to the larger population of ASD. Future studies could also incorporate some additional elements as discussed below.

The particular semantic relations of the vocabulary words produced by the child should be examined in more detail. Analysis of the semantic roles of vocabulary most frequently produced by the child would provide valuable information when selecting target vocabulary for use in the intervention. For example, if the child produced *agent + action* combinations most frequently within intervention, this would imply the child had the most success creating semantic combinations that mapped to actual experiences. This finding might suggest that these types of combinations should be emphasized in the initial phases of the intervention with introduction of more abstract semantic content at a later stage.

Results of this study indicated that the structure of the sequenced procedure and book sharing conditions promoted the production of semantic combinations in a child with ASD. For the current study, the presentation of the picture symbols was held consistent across all conditions in the form of a six-symbol communication board to allow comparison of the target vocabulary across the conditions. Due to the outcomes found for the structured tasks, future research should manipulate variables within the context of a sequenced procedure or book sharing condition to more explicitly address the hypothesis that the external structuring provided by these activities was an important element for eliciting combinatorial communication. For example, the current study could be replicated using a variation of picture symbol presentations (e.g., communication board and sentence strips) within each of the structured tasks. This would

provide information on the impact the format of the picture symbol presentation has on the production of semantic combinations.

Summary

AAC intervention approaches have been explored as a means of supplementing natural speech in children with ASD who are minimally verbal. One specific technique, aided language stimulation has been reported to increase symbol comprehension and production for these individuals; however, little research has been focused on the use of aided language stimulation techniques to promote the use of combinations of semantic concepts in children with ASD who are minimally verbal. Another aspect of intervention that has received little consideration is how to address potential word retrieval deficits in this population of children. A large percentage of children with ASD are considered to be low verbal with relatively intact semantic or word learning knowledge, suggesting the possibility of word retrieval deficits in this population. Intervention principles to address word retrieval deficits have been developed based on work with children with specific language impairments. However, these principles have not been generally applied for targeting difficulties with word retrieval in children with ASD.

This single-subject study found that aided language stimulation intervention in the context of a semantically-based therapeutic approach had a small effect on the child's production of single spoken words with a large effect on production of picture symbol combinations and word + picture symbol combinations in child with ASD and minimal spoken language skills. The facilitated play condition was most effective in eliciting single spoken word productions whereas the sequenced procedure and book sharing conditions were most effective in eliciting picture symbol combinations. Throughout the study, the participant also demonstrated the ability to communicate more conceptual knowledge through words + picture symbols than by words alone.

Word retrieval interventions, including the repeated modeling of a small number of target words/symbols to promote rehearsal across the conditions did not appear to be effective in promoting use of these specific items.

Future studies should focus on structured tasks, due to the significant impact these tasks had on production of semantic combinations. Various representations of picture symbols should be manipulated to evaluate presentation effect on performance. Additionally, semantic roles of the vocabulary produced by the child should be analyzed to provide further information for vocabulary selection.

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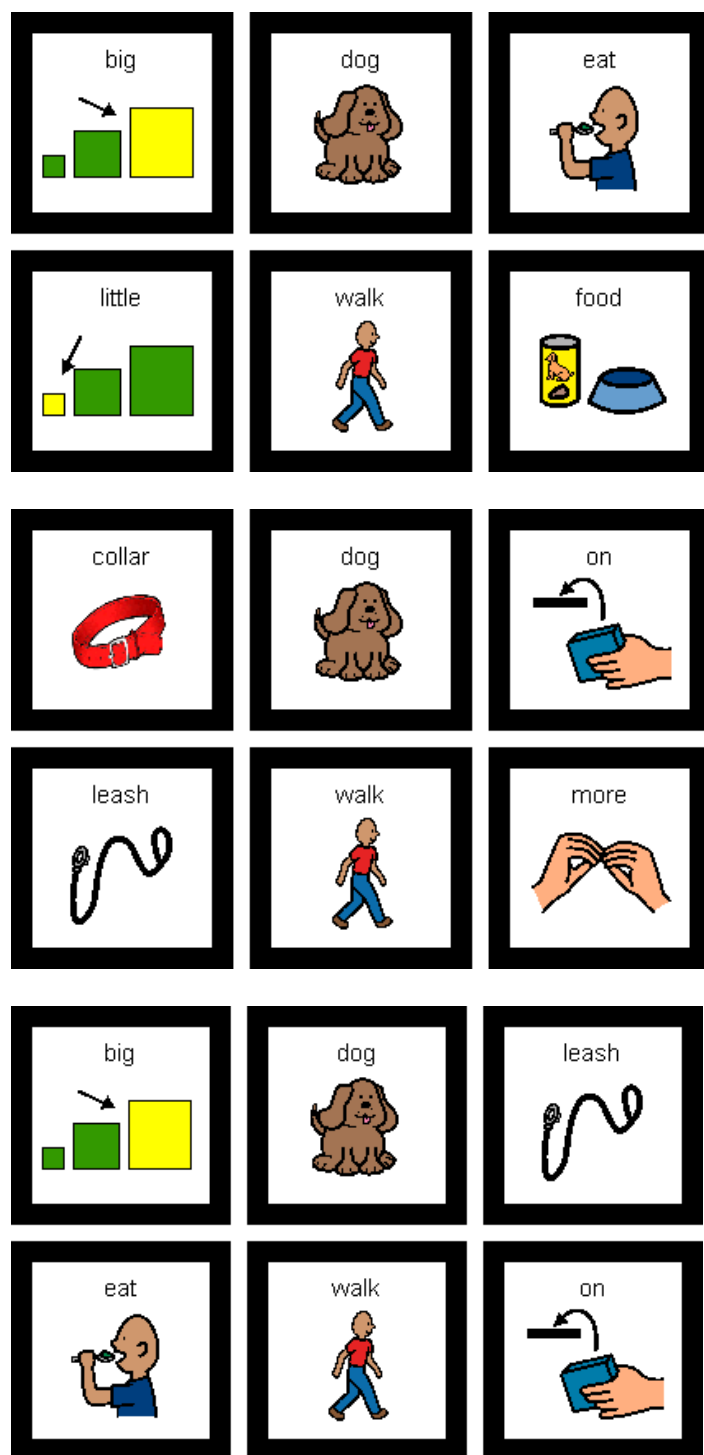
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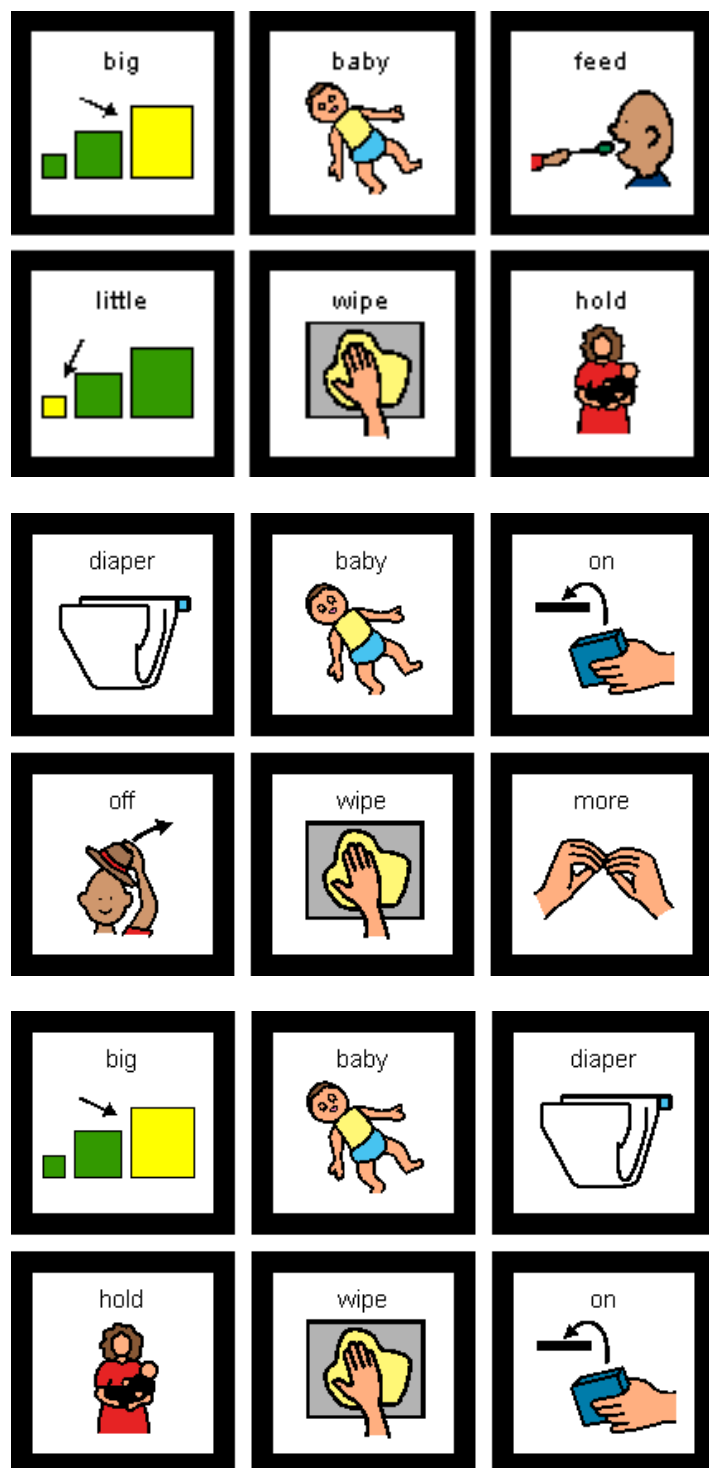
Appendix A. Communication Boards for “Dog Theme”



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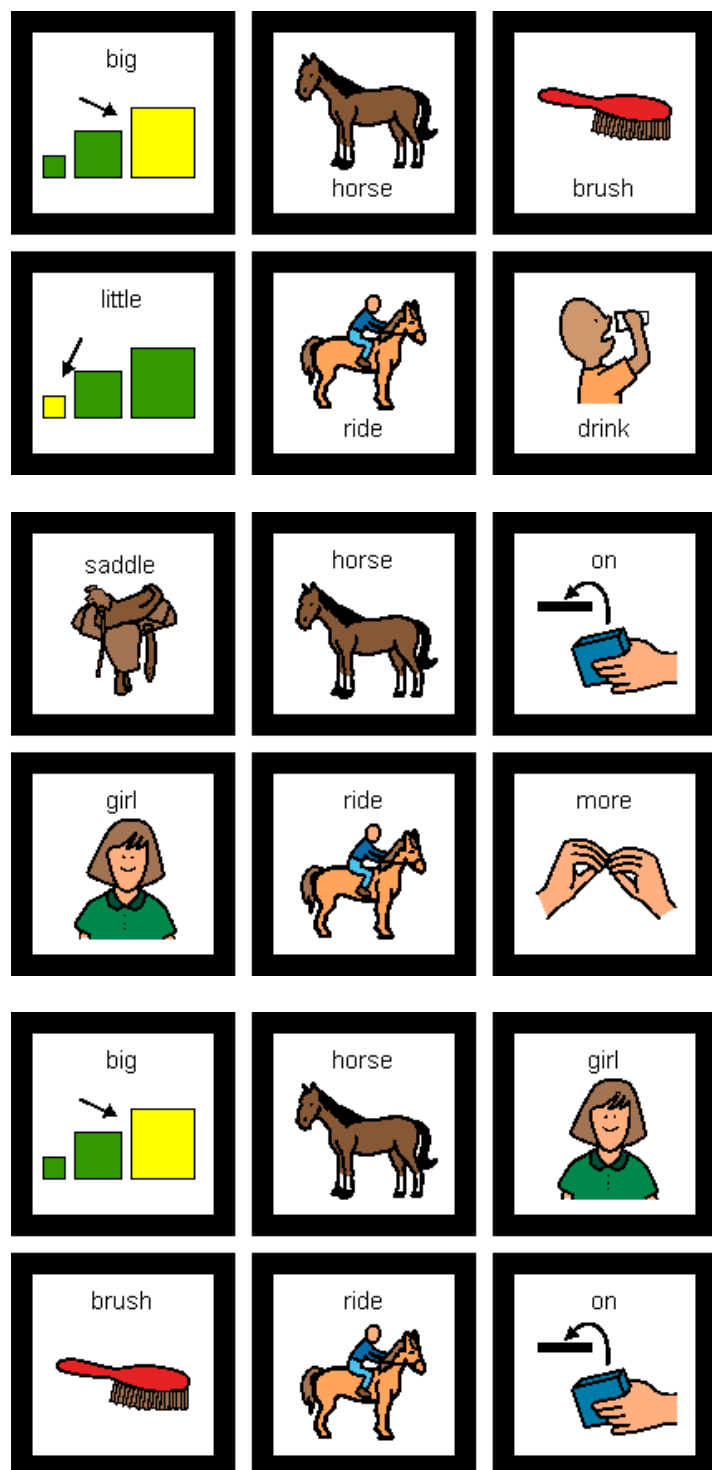
Appendix B. Communication Boards for “Baby Theme”



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Appendix C. Communication Boards for “Horse Theme”



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Appendix D: Semantic Roles Coding Sheet

Action
Locative
Agent
Object
Demonstrative
Recurrence
Possessor
Quantifier
Experiencer
Recipient
Beneficiary
Comitative
Created Object
Instrument
State
Entity (one-term)
Entity (multiterm)
Negation
Attribute
Adverbial

Appendix E:

Interview

Do you have any questions before we begin?

1. Now that we've finished the intervention with your child, what are your impressions of it? –In general I think it went well. She responded to the picture cards very well.

2. Follow-up questions:

- **Do you think this intervention was beneficial for your child?** – Yes it was beneficial.
- **Do you think that your child enjoyed the intervention?** – As long as it was something rotated around what she liked, then yes.
- **Are there any ways you think the intervention could be improved?** – Just not going off such strict routines and going off activities that she liked, which would actually make her talk more.

3. Have you noticed any differences in your child's spoken language? If so, can you tell me about that? – Yes, oh she has more words. She puts two words together.

Follow-up questions:

- **Can you give me some examples of new words you have heard your child use?** – She says go away and good night. She's trying to say Connor. She's doing two syllable words. Her cousin is Donte and she says that.
- **Has anyone else mentioned differences in your child's spoken language skills?** – Yes, yes family who don't see her all the time. At school her teacher's say she's making a ton of progress.

4. I'd like some feedback regarding the intervention length and content.

Follow-up questions:

- **What other types of activities could we have used that you think your child would have enjoyed?** - She really loves things on the playground like bubbles and balls. She loves the beach so even like sand and summer.

5. Do you think the sessions were too long for your child? - No I think she just needed a little free time, but not to leave the room. When she leaves the room she doesn't want to go back in. But just a little space every few minutes I think does her well.

6. I'd like your impressions of the usefulness of this intervention in the home environment.

Follow-up questions:

- **Have you already used it at home? Can you give me some examples?** – She uses the picture cards sometimes, like the ones we have. She has picture cards in her room with the toys. She is really trying to say words. We had a picture card for bubbles, but now she just tries to say bubbles.

- **What would make it difficult to use at home?** – It depends on what it is. Some things are easier to use picture cards with than others.
- **We have had the opportunity to talk about many ideas about aided language stimulation intervention and I have asked you many questions. In closing, is there anything else you'd like to tell me about?**
 - No I think it was a good experience for her.